Scoping Report

Spaulding Turnpike Improvements
NHS-027-1(37), 11238

Newington to Dover
New Hampshire

March, 2004

Federal Highway Administration

New Hampshire Department of Transportation

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Prepared for **New Hampshire Department of Transportation**
Concord, New Hampshire

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Bedford, NH

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1 Purpose and Need

1.1 Introduction

This Scoping Report documents the first of five phases of the Environmental Impact Statement (EIS) to evaluate improvements to a 3.5 mile segment of the Spaulding Turnpike (US 4/NH 16) transportation corridor between the Exit 1 (Gosling Road) interchange in Newington and through the Exit 6 (US 4/Dover Point Road) interchange just south of the Dover Toll Plaza in Dover, New Hampshire. The report includes a statement of the purpose and need for the project, a discussion relative to the study area limits, a summary of the conceptual alternatives, a description of existing environmental resources (natural, cultural, and socio-economic) within the study area and currently known issues of concern with respect to implementing project alternatives.

Phases of the study are in accordance with the National Environmental Policy Act (NEPA) requirements and with a format established by the New Hampshire Department of Transportation (NHDOT)[1] that include:

- Phase I: Establishing the Scope of the Project and Defining Existing Resources (resulting in this Scoping Report)
- Phase II: Screening of Conceptual Alternatives resulting in a Rationale Report
- Phase III: Preparation of a Draft Environmental Impact Statement (DEIS)
- Phase IV: Public Hearing
- Phase V: Preparation of a Final Environmental Impact Statement (FEIS)

The process has the following key decision points:

- Concurrence with Purpose and Need (ACOE)
- Practicable Alternatives Sign-Off (ACOE)
- Approval of Draft EIS (FHWA)
- Report of the Special Committee (State of New Hampshire)
- Least Environmentally Damaging Practicable Alternative Sign-Off (ACOE)
- Sign-off on Appropriate Wetland Mitigation (ACOE)
- Approval of Final EIS (FHWA)

[1] See Appendix A for a list of acronyms used in this Scoping Report.

- Record of Decision (FHWA)
- State Wetland Permit (NHDES)
- Section 401 Water Quality Certification (NHDES)
- State Coastal Zone Management Consistency Determination (NHOSP)
- Section 404 Permit (ACOE)
- US Coast Guard Bridge Permit

During the course of the study process, public participation will be a key element relative to evaluating resources, impacts, and alternatives. An Advisory Task Force (ATF) has been established. The ATF is comprised of two representatives of each of the municipalities of Dover and Newington; single representatives of the municipalities of Durham and Portsmouth; and single representatives of the Rockingham Planning Commission (RPC), the Strafford Regional Planning Commission (SRPC), the Pease Development Authority (PDA), Cooperative Alliance for Seacoast Transportation (COAST), the Greater Dover Chamber of Commerce, the Portsmouth Chamber of Commerce, the Great Bay Estuarine Research Reserve, the Federal Highway Administration (FHWA), and the Department of Transportation (NHDOT). The ATF is expected to meet approximately every three months in the evenings, with meeting locations rotated between Dover and Newington. The public has been encouraged to attend. In addition, a project website, www.newington-dover.com, has also served as a forum to provide project-related information to the public, and to solicit their feedback and comment.

Public Officials Meetings and Public Informational Meetings will be held periodically in both Newington and Dover.

A project Scoping Meeting[2] conducted at Newington Town Hall (June 25, 2003) and a Public Information Meeting[3] conducted at Dover City Hall (November 12, 2003) provided opportunity to brief local officials and the public on the background, purpose and need of the project. Study area, affected environment, potential impacts that may warrant study and identification of a reasonable range of alternatives were discussed and confirmed. The project schedule and study process were outlined. These meetings also afforded local officials and the public an opportunity to raise issues of concern and suggest ideas to address the project purpose and need.

This Scoping Report will provide the basis in part for the "Purpose and Need for the Proposed Action" and "Affected Environment" of the DEIS. The report represents a cooperative effort among the FHWA, the New Hampshire Department of Transportation (NHDOT) and the project consultants. The consulting team consists of:

[2] See Scoping Meeting notes in Appendix B.

[3] See Public Informational Meeting notes in Appendix C.

Bridge, Roadway and Traffic Engineering:	Vanasse Hangen Brustlin, Inc.
Bridge Engineering:	Hardesty and Hanover, LLP
Environmental Analysis:	Vanasse Hangen Brustlin, Inc.
Socio-Economic/Secondary Impacts:	RKG Associates, Inc.
Marine Habitat/Resources and Hydrodynamic Analysis:	University of New Hampshire
Historical Resources:	The Preservation Company
Archaeological Resources:	Victoria Bunker and Associates
Travel Demand Modeling:	Resource Systems Group
Environmental Regulatory Coordination:	James J. Bajek, LLC

1.2 Project Setting and Overview

The Spaulding Turnpike is eastern New Hampshire's major limited access North-South highway. **(Figure 1.2-1)** The 3.5 mile Newington-Dover section of the Turnpike also functions as an extension of the US 4 and NH 16 transportation

Hilton Park (Looking South)

corridors linking the Seacoast area and I-95 with Concord to the west and the White Mountains to the north, respectively. Recognizing a need to study potential improvements to address safety concerns and increased congestion, Senate Bill 152-FN-A (1990) authorized the NHDOT to conduct a study of the approximately 3.5-mile section of the Spaulding Turnpike extending north from Exit 1 (Gosling Road) in Newington and traversing the Little Bay Bridges to (but not including) the Dover Toll Plaza just north of Exit 6 (**Figure 1.2-2**). Locally, this section of the Turnpike also

connects with Dover Point Road (Dover) to the north and Nimble Hill Road, River Road and Woodbury Avenue (Newington) to the south. The study was initiated in 1990 but suspended in 1992 to allow completion of the Pease Surface Transportation Master Plan. In 1997, the Newington-Dover Feasibility Study was initiated to conceptually develop both a short-range plan to address existing safety deficiencies, and a range of long-term improvement alternatives to be carried forward for detailed engineering and environmental studies. The study was completed in 2000[4].

Exit 4, Nimble Hill Rd/River Rd
(Looking North)

In 1998, the Route 16 Corridor Protection Study[5] articulated a vision for the corridor (Portsmouth to Errol) to guide future growth and identified a number of planning principles and techniques to address the following major areas of concern: transportation, community design, travel and tourism, and land use and access management. The vision for the corridor and study findings and recommendations resulted from a cooperative effort of working groups of people who reside and work in the corridor with support from state and regional planners. As part of the study, which underscores the linkage among transportation, economy and land use, 1997 and future (2017) year travel conditions along the corridor – including the Spaulding Turnpike – were evaluated taking into account future changes in land use and

[4] VHB, Spaulding Turnpike Improvements, Feasibility Study, Newington-Dover (11238), February 2000.

[5] NHDOT, Route 16 Corridor Protection Study, December 1998.

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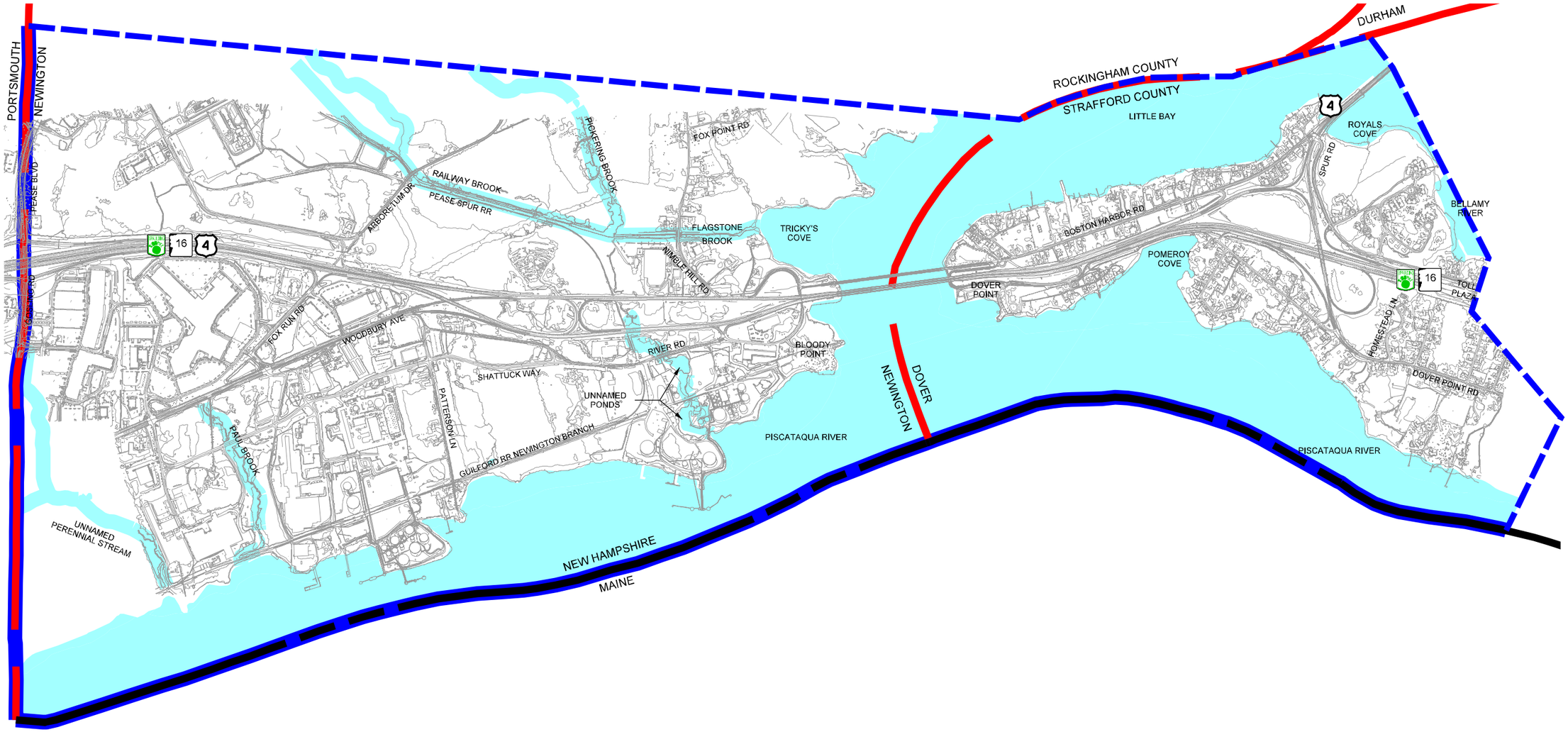
Figure 1.2-1
Project Location Map

New Hampshire DOT
Department of Transportation



Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- STUDY AREA BOUNDARY

0 750 1500 Feet

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Figure 1.2-2
Project Study Area

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transportation improvement projects that were programmed for project development. The traffic analysis indicated that while the section of Turnpike north of the Dover Toll Plaza would operate at a satisfactory level-of-service[6] under future (2017) conditions, the 3.5-mile study area section of Turnpike between the Dover Toll Plaza and Exit 1 (Gosling Road) in Newington is capacity constrained under both 1997 and 2017 future traffic conditions.

Within the framework of an EIS, this current study will identify, evaluate and recommend a long-term transportation and safety solution for this study area that is practical, permittable, affordable, and supported by community stakeholders while addressing the project's purpose and need.

The study area lies geographically in the Seaboard Lowland section of New England, with most of the land lying between sea level and 60 feet above sea level. This area lies within the Great Bay Drainage and Coastal Drainage watersheds, which make up the larger Salmon Falls – Piscataqua Rivers drainage basin. The northern one-third of the study area, located within the portions of Little Bay and Bellamy River is tributary to the Piscataqua River which drains to the Atlantic Ocean. Other perennial watercourses in Newington include Pickering Brook, a portion of Railway Brook and an unnamed stream which flow into the Piscataqua River, and Flagstone Brook and a portion of Railway Brook which flow into Little Bay at Tricky's Cove. These and other resources are discussed in greater detail in Sections 3 and 4 of this report.

Seven (7) rail corridors have been identified (**Figure 1.2-3**) for evaluation of improved rail transportation as part of this study. Of the seven corridors, three (Main Line West, Main Line East, and the Conway Branch) may have potential for passenger rail service improvements, and six (Main Line West, Main Line East, Conway Branch, Newington Branch, Portsmouth Branch, and the Pease Spur) are potential candidates for improved freight service. These rail corridors may have the potential for reducing passenger and commercial vehicle travel demand on the Spaulding Turnpike and other study area roadways. Issues pertinent to the feasibility of improving rail transportation include identification of infrastructure requirements, operational issues, equipment requirements, passenger stations and commercial shipping/receiving locations, potential ridership and market demand, and cost. These issues will be evaluated as part of this study.

Discussion of these rail corridors is summarized in Section 2.4.1.

▼

[6] Level of service (LOS) is a qualitative measure describing operational conditions within a traffic stream and their perception by a motorist or passenger. Level of service generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and, in doing so, provides an index to quality of traffic flow. Six levels of service are defined ranging in letter designation from LOS A to LOS F, with LOS A representing the best traffic operation and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak and design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustified. LOS E reflects traffic operations at capacity.

The section of Spaulding Turnpike being studied (**Figure 1.2-2**) is approximately 3.5 miles long extending south from the Dover Toll Plaza to just north of Exit 1 in Newington, and includes the Little Bay Bridges. Most of this section of the Turnpike is a limited access[7] facility and consists of two (2) through lanes in each direction separated by a median of varying width. The study area includes five interchange areas (Exits 2, 3, 4, 5 and 6) including a median turnaround (Exit 4N) to accommodate southbound traffic desiring to reverse direction or access River Road in Newington.

For purposes of inventorying environmental resources which might be directly impacted as a result of improving the transportation system, the primary study area is generally defined as a band approximately 3,000 to 5,000 feet east of the northbound lanes, including the Piscataqua River and Pomeroy Cove, a band approximately 3,000 to 5,000 feet west of the southbound lanes, including the General Sullivan Bridge and Little Bay, and the median areas. These band widths include the interchange areas and connecting roadways.

As previously mentioned, the 1998 Route 16 Corridor Protection Study and the 2000 Newington-Dover Feasibility Study established the project study area limits by determining that current and future Turnpike traffic operating conditions north of the Dover Toll Plaza were satisfactory. In contrast, there are poor levels of traffic service on the section of Turnpike south of the Dover Toll Plaza and north of Exit 1 in Newington under current and future volume conditions.

These boundaries mark the extent of potential direct impact to environmental resources. They do not, however, limit the evaluation of Transportation Demand Management (TDM) measures[8] and mass transit alternatives, which may logically have to extend further to the north or south. For the purpose of evaluating secondary and cumulative impacts, consideration must be given to those areas serviced by, and thus subject to the influence of, the 3.5-mile section of the Turnpike in Dover and Newington under study. As such, a broad regional area (**Figure 1.2-4**) was defined to include 30 municipalities within the tri-county area of Strafford, Rockingham and Carroll Counties in the southeast portion of New Hampshire. This area is broadly referred to as the Seacoast area and was used as a basis to collect and analyze regional socio-economic data in order to provide a context within which to evaluate the proposed 3.5-mile Turnpike improvement project and its potential secondary impacts (Section 3.10).

[7] The existing Exxon-Mobil service station located at the Nimble Hill Road/Turnpike intersection has direct access to the Turnpike and Nimble Hill Road, along with several other parcels in Newington.

[8] Transportation Demand Management (TDM) programs aim to improve mobility and access, reduce congestion and air pollution, and provide options for employees to get to work without increasing highway capacity. The most common TDM measures include provisions for park and ride lots, discounts or preferential treatment for vehicles serving more than one rider, improved public transit services (*e.g.*, express bus service), work hours management and other incentives which encourage the use of public transit, car pooling, biking, walking, or simply not making the trip.

New Hampshire DOT
Department of Transportation

Legend:
- Downeaster (AMTRAK)
- Guilford Rail System
- NH - North Coast Rail
- AMTRAK Station
- State Line
- Town Line

0 1.5 3 Miles

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Figure 1.2-3
Existing Rail Corridors

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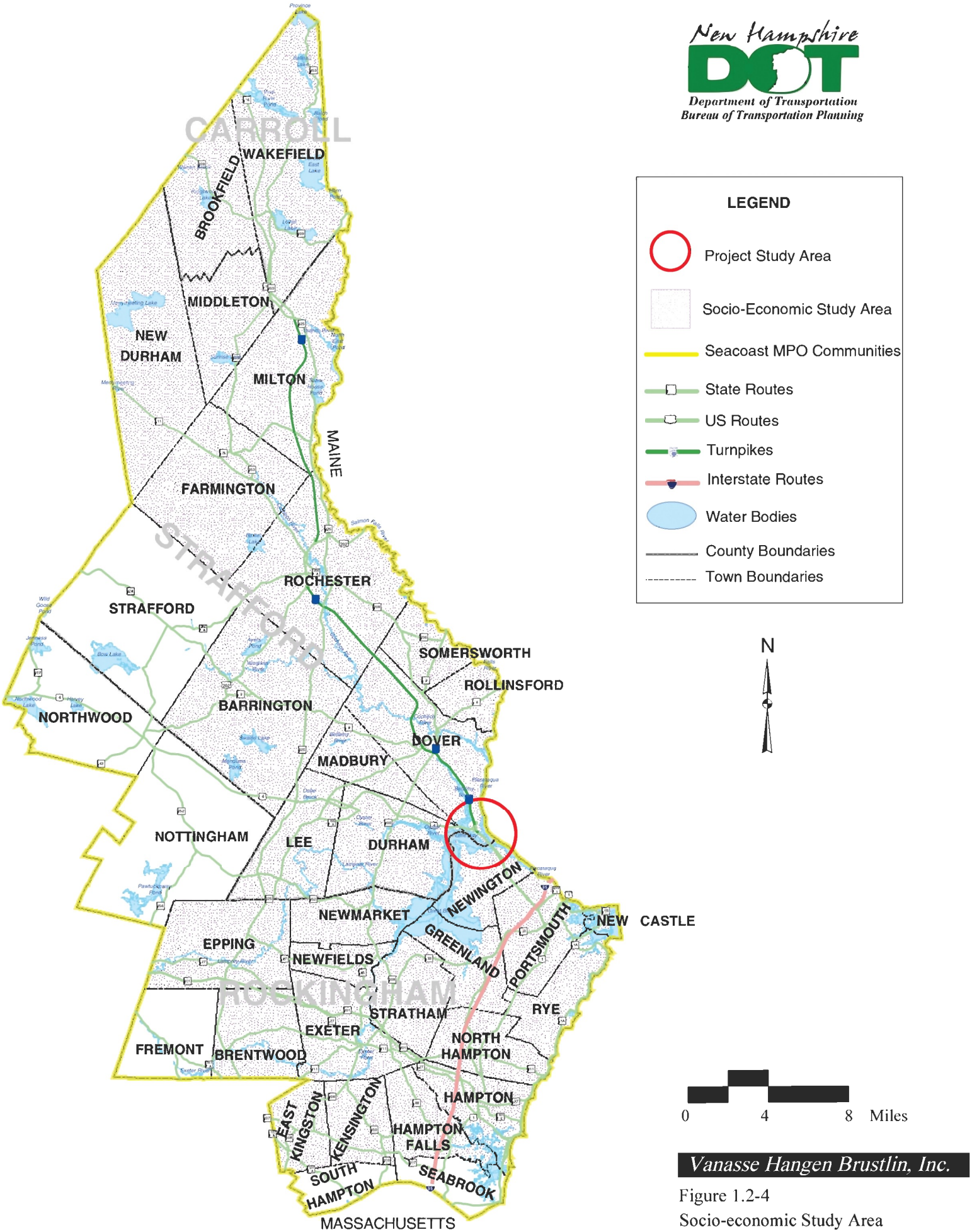

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Figure 1.2-4
Socio-economic Study Area

1.3 Existing Roadway System

The Spaulding Turnpike (NH 16) is a major limited access highway connecting the Seacoast Region with Concord, the Lakes Region and the White Mountains. The Turnpike is also part of the National Highway System (NHS) and is functionally classified as a principal arterial, serving commuters, tourists and recreational traffic. It is the region's major north-south route of commerce.

During the commuter weekday peak hours (7:00-8:00 AM, 5:00-6:00 PM), study area motorists traveling along the Spaulding Turnpike currently experience traffic congestion and substantial delay. Poor traffic flow conditions can be attributed to two separate factors: high traffic volumes and physical infrastructure deficiencies. With the Little Bay Bridges currently carrying in excess of 70,000 vehicles per day, many of the freeway segments and interchanges along the highway experience volume demands that exceed the available capacity of the roadway system. Of the 41

Exit 6 (Looking North)

Individual traffic flow movements (freeway segments, ramps, weave areas, and intersections) evaluated in the study area under the existing conditions (2003) analysis, 17 locations (34 percent) were determined to be deficient in capacity, operating at level of service (LOS)[9] E or F during the weekday morning or evening commuter peak hours. Most notably, traffic operations between Exits 3 and 6 were found to be very poor under the existing conditions operating at a LOS E.

[9] Level of Service (LOS), See Note 6, page 1-9

In addition to the high volume demands, the physical features of the Spaulding Turnpike contribute toward the poor traffic flow. Physical deficiencies along the Turnpike include substandard curvature along interchange ramps, inadequate acceleration and deceleration lanes at interchanges, inadequate weave distances between access points, and substandard shoulder widths, and constrained vertical sight lines on the Little Bay Bridges. These factors often result in reduced travel speeds, constrained maneuverability, and congestion during the peak hour conditions.

Traffic operations are expected to continue to deteriorate under future conditions as traffic volumes increase. Traffic forecasts for the year 2025 show that the average annual daily traffic (AADT) on the Little Bay Bridges could reach 101,800 vehicles per day. This volume of traffic would substantially increase the current level of congestion along the Spaulding Turnpike and its interchanges, and along nearby

Exit 3 (Looking North)

local roadways such as Dover Point Road, River Road and Woodbury Avenue. The additional delay experienced by motorists would be expected to expand to more hours of the day and to a greater number of days during the year. Accident frequency would also be expected to increase as a result of the increased level of congestion.

The annualized average daily traffic (AADT) along study area segments of the Spaulding Turnpike for the 2003 Existing and 2025 Design Year conditions is summarized in Table 1.3-1.

Table 1.3-1
Spaulding Turnpike Average Annual Daily Traffic (2003 and 2025)*

Segment	2003 AADT (VPD)**	2025 AADT (VPD)
Between Exits 1 and 2	54,700	77,400
Between Exits 2 and 3	52,900	76,200
Between Exits 3 and 4	69,300	96,900
Between Exits 4 and 5 (Little Bay Bridges)	70,650	101,800
Between Exits 5 and 6	71,050	102,200
North of Exit 6	39,800	57,500

* AADT's for 2003 are based on data collected by the NHDOT. AADT's for 2025 are based on the Seacoast MPO Traffic Model.
** VPD = vehicles per day.

Safety Issues/Accident Data

A review of study area accident data for the ten-year period of January 1992 through December 2001 revealed a total of 1,483 accidents. Of these accidents, 575 accidents occurred during the five-year period of January 1992 through December 1996. The remaining 908 accidents occurred over the most recent five-year period from January 1997 through December 2001, representing a 58 percent increase from the previous period.

Focusing on the 1997 through 2001 time period, the frequency of accidents within the study area grew at an average rate of 11 percent per year increasing from 144 accidents in 1997 to 220 accidents in 2001. It is interesting to note that study area traffic volumes along the Spaulding Turnpike grew at a much lower rate of 3 percent per year during this same time period. The fact that the number of accidents is increasing at a faster rate than traffic volume growth is an indicator of the deterioration of the safety along the corridor and the severity of the congestion level.

The highest number of accidents reported on the Spaulding Turnpike occurred on the Little Bay Bridges where there were 97 accidents from 1997 through 2001. During the years 1997, 1998, and 1999, approximately 15 accidents per year occurred on the bridges. This number increased substantially to 24 and 28 accidents per year in 2000 and 2001, respectively. Other segments of the Turnpike experienced much lower accident rates ranging between 5 and 25 accidents over the five-year analysis period.

There were no reported fatalities during the 1997-2001 period.

From a bridge perspective, the Turnpike within the study area was expanded from two to four lanes (two lanes in each direction) in 1966 with the construction of the current southbound Little Bay Bridge. This new bridge – originally operating in the

northbound direction – combined with the existing 2-lane General Sullivan Bridge (constructed in 1935) to provide a four-lane crossing (two lanes in each direction) of Little Bay. In 1984, the current northbound Little Bay Bridge was constructed which coincided with the closing of the General Sullivan Bridge to vehicular traffic. The four-lane (two lanes in each direction) crossing of Little Bay has been maintained since 1966, and the General Sullivan Bridge has been restricted to use by pedestrians and bicyclists because of its poor condition.

Since the closing of the General Sullivan Bridge and the reconstruction and realignment of the northerly approaches to the expanded Little Bay bridges in 1984, no substantial changes have occurred to this section of the Spaulding Turnpike. Minor modifications were added in 2001 to allow management of traffic crossing the Little Bay bridges during emergency response situations.

A number of related study area transportation improvement projects are currently in various stages of project development.

- An interim safety improvement project in Newington at Exits 4 and 4N is under design and targeted for FY 2005 construction. A Public Hearing was held on March 5, 2003 to gather layout approval. As proposed, reconstruction of on and off ramps at Nimble Hill Road and River Road, construction of a two-way connector beneath the Turnpike via the extension of River Road to Nimble Hill Road, and the elimination of the Exit 4N median turnaround will improve traffic operations and safety in the vicinity of Exit 4.

- A project to improve management of incidents (accidents and breakdowns) within the study area and on the Little Bay Bridges is scheduled for 2004 implementation. The project includes erection of permanent and temporary variable message signs in conjunction with the deployment of emergency response vehicles and improved coordination of state and local emergency response officials to reduce delays in restoring normal traffic conditions. Communication with motorists (via radio caller information service and website information) will be in real time, recommending actions in response to study area traffic conditions.

- New Hampshire Fish & Game Department (NHF&GD) is currently studying the future reconstruction of the boat ramp in Hilton Park to allow full-tide access. Access to the park is via Exit 5 or Boston Harbor Road. Reconstruction of the boat ramp in Hilton Park would be a collaborative effort between NHF&GD and NHDOT.

- Shattuck Way is a partially (2002-2003) constructed industrial access road in Newington running parallel to the Turnpike and Woodbury Avenue and connecting River Road and Simplex Drive. The River Road connection provides

access to the Turnpike via Exit 4; Piscataqua Drive provides access to Woodbury Avenue.

1.4 Purpose and Need for Action

The purpose of this project is to improve transportation efficiency and reduce safety problems, while minimizing social, economic, and environmental impacts, for an approximate 3.5-mile section of the Spaulding Turnpike extending north from the Gosling Road/Pease Boulevard Interchange (Exit 1) in the Town of Newington, across the Little Bay Bridges, to a point just south of the existing Toll Plaza in the City of Dover. Options that include implementing Transportation System Management (TSM) improvements[10], reusing the General Sullivan Bridge for local motorized and non-motorized traffic, enhancing rail service, improving bus transit service and instituting other Transportation Demand Management (TDM)[11] strategies that may reduce vehicle trips along the Spaulding Turnpike will be considered, in addition to upgrading the mainline, Little Bay Bridges, and interchanges.

The Spaulding Turnpike is eastern New Hampshire's major limited access north-south highway, serving as a gateway linking the Seacoast Region with Concord, the eastern portion of the Lakes Region, and the White Mountains. The Turnpike is also part of the National Highway System (NHS) reflecting its significance as an important transportation link in the State and regional system. Functionally classified as a principal arterial, it is a major commuter route which ties the growing residential areas of Dover-Somersworth-Rochester with the industrial and regional commercial centers in Newington, Portsmouth, and northern Massachusetts. It serves as the major artery for freight into and out of the areas north of the Little Bay Bridges, and is the economic lifeline of the region. It also serves as a major tourist route, providing access to the northern reaches of the state from the seacoast and points south of New Hampshire.

Traffic volumes on the Little Bay Bridges have steadily increased from approximately 30,000 vehicles per day in 1980 to greater than 70,000 vehicles per day in 2003 resulting in high levels of congestion on the bridges and along the Turnpike near and within the interchange areas. Over the next 22 years this average daily volume is expected to increase to approximately 100,000 vehicles per day. During weekday and weekend peak hours of the day, the Turnpike currently operates at unacceptable levels of service (LOS E and/or F) with motorists experiencing severe congestion and long delays within this segment of the corridor.

[10] Transportation System Management (TSM) improvements are generally low-cost measures to reduce congestion and improve safety. TSM improvements are typically limited by the width of the existing right-of-way. Examples of TSM improvements include the construction of turning lanes, re-striping lane uses and installation of traffic signals or roundabouts to improve traffic control and/or traffic flow efficiency.

[11] Transportation Demand Management (TDM), see Note 8, page 1-9.

The Turnpike has a number of existing geometric deficiencies including limited sight distance and substandard shoulder width on the Little Bay Bridges and substandard merge, diverge, and weave areas at the interchanges. Many of the traffic maneuvers required to enter, exit or change lanes along this section of the Turnpike are capacity constrained under current traffic conditions and contribute to driver discomfort and accidents. Existing acceleration, deceleration and weaving sections along the Turnpike are inadequate by current design standards. Historic accident data indicates that the frequency of crashes continues to increase raising concerns relative to motorist safety. Due to the nature of the existing facilities, these crashes create long delays in an area for which there are no viable alternate routes.

In addition to the capacity deficiencies and safety issues, this section of the Turnpike bisects the residential and recreational areas in Dover and the residential and commercial/industrial areas in Newington resulting in an inefficient and circuitous use of the Turnpike by people desiring to travel east-west and vice versa. Local connectivity for motorists, pedestrians, and bicyclists from one side of the Turnpike to the other is deficient.

This section of the Turnpike is located in a moderate seismic region, identified as Seismic Performance Category B. The Little Bay Bridges and General Sullivan Bridge, which are classified as major structures, were not designed to meet the current seismic design criteria for this region.

The project is included in the State's Ten-Year Transportation Improvement Program and is the top long-term transportation priority of the Seacoast Metropolitan Planning Organization (MPO). As residential and commercial development and traffic growth along the corridor continues, traffic operations and safety conditions will deteriorate further, resulting in increased vehicle delays, increased accident frequency, and the potential loss of commerce.

In addition, the project will address potential oil spill issues, water quality issues, and air quality issues.

2

Conceptual Alternatives

2.1 Introduction

As part of the development of the Draft Environmental Impact Statement a number of alternatives will be evaluated. Study alternatives generally include the following:

- No build,
- Implementation of Transportation System Management (TSM) Improvements,
- Implementation of Transportation Demand Management (TDM) Strategies,
- Upgrading the corridor, and
- Combinations of these.

An analysis of alternative bridge/highway corridors involving a major relocation of the Little Bay Bridges or the Spaulding Turnpike is not proposed due to the sensitive environmental location (coastal wetlands, Hilton Park, historic and prehistoric resources), the proximity of residential neighborhoods, the magnitude of required investment and current study area traffic patterns. A brief summary of the study alternatives follows.

2.2 No-Build Alternative

The National Environmental Policy Act (NEPA) requires that all environmental impact studies evaluate fully all reasonable or viable alternatives, including the No-Build Alternative. The No-Build Alternative would maintain the existing infrastructure without any improvements.

The No-Build Alternative is essentially the continuation and perpetuation of the existing situation and the shortcomings inherent on the present transportation corridor. Given current traffic volumes and with traffic volumes expected to rise substantially over the next 20 years, this alternative would not meet the project purpose and need, and in fact would result in a worsening situation relative to transportation safety and mobility. Therefore, the No-Build Alternative will serve as the baseline condition for comparison to other alternatives. However, it is not considered a reasonable alternative if the project purpose and need are to be addressed.

2.3 Transportation System Management Improvements

Transportation System Management (TSM) improvements are generally low-cost measures to reduce congestion and improve safety. TSM improvements are typically limited by the width of the existing right-of-way. Examples of TSM improvements include the construction of turning lanes, re-striping lane uses, installation of traffic signals or roundabouts to improve traffic control and/or traffic flow efficiency; upgrading traffic signals, ramp metering and changes in traffic patterns may also increase traffic flow efficiency. The Exit 4 Interim Safety Plan (scheduled for construction in Fiscal Year 2005) that eliminates traffic weaving conflicts and improves on and off ramp geometry, and the 2004 scheduled implementation of the Little Bay Bridges Incident Management Plan are study area examples of moderate-cost TSM-type improvements. These improvements are not intended to address the existing or projected future capacity deficiencies of the study area, but are intended to address current safety and traffic operational problems on a short-term basis.

In the case of the Spaulding Turnpike corridor and interchanges, additional TSM improvements may be identified and evaluated. They include:

- Ramp metering at selected locations (*e.g.*, northbound River Road entrance ramp),
- Minor widening, re-striping and traffic control alternatives at intersections,
- Improving acceleration and deceleration lanes,
- Changes in local traffic circulation.

Although a relatively high-cost measure, the rehabilitation and use of the General Sullivan Bridge to convey local or dedicated transit traffic may be viewed as a TSM improvement.

2.4 Transportation Demand Management Strategies

Transportation Demand Management (TDM) includes measures that remove traffic from the roadway rather than increase the highway capacity. These measures, encouraged by federal legislation such as the Clean Air Act Amendments (CAAA) of 1990, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and the Transportation Efficiency Act for the 21st Century (TEA-21), offer various actions that can be taken to reduce single-occupancy automotive travel and improve traffic flow. The most common TDM measures include provisions for park and ride lots, discounts or preferential treatment for vehicles serving more than one rider, improved public transit services (*e.g.*, express bus service) and other incentives which encourage the use of public transit, car pooling, biking, walking, or simply not making the trip.

TDM measures range from enticements encouraging change in mode of travel from personal vehicle to public transit, to extreme travel restrictions that reduce vehicle trips by simply prohibiting them. The most common TDM techniques emphasize travel behavior modification by changing the mode and time of travel for the work trip. TDM measures cover a wide range of voluntary and/or mandatory techniques that have been implemented with varying degrees of success nationwide. These include, but are not limited to:

- Ride-Sharing (car pools, van pools with ride-matching services),
- Work Hours Management (flex-time, staggered work hours, modified work schedule),
- High-Occupancy Vehicle (HOV) incentives,
- Transit Usage (buses, trains),
- Bicycle Usage,
- Telecommuting (employees working at home),
- Parking Restrictions, Incentives/Disincentives,
- Park and Ride Facilities,
- Developer Requirements (such as preferential parking for ride-sharing vehicles, provision of sidewalk connectivity and bus stop shelters, tenant/employer support of employee transit passes, and provision of bicycle racks, employee shower facilities and cafeterias),
- Travel Restrictions, and
- Congestion Pricing (toll prices based on vehicle occupancy and time of day, etc.).

At this time, the likelihood of success in implementing mandatory or overly restrictive TDM strategies for either motorists or employers, or both, is low. Strategies that now, or in the future, are worthy of more in-depth evaluation include:

- Developing or otherwise enhancing passenger and freight rail service,
- Improving bus service,
- Providing park and ride facilities,
- Promoting ride-sharing, and
- Constructing HOV lanes (Section 2.5, High Occupancy Vehicle Lanes).

The following sections summarize the existing circumstances regarding these potential measures.

■

2.4.1 Rail Transportation

Seven rail corridors have been identified for the evaluation of improved rail transportation as part of the study. Of the seven corridors, three are potential candidates for passenger rail service improvements, two are candidates for fixed guideway transit systems (*i.e.*, light rail or bus rapid transit), and six are candidates for improved freight rail service. Corridors to be evaluated for passenger rail service

improvements include the Main Line West that currently hosts the *Downeaster* intercity passenger rail service, the Main Line East, and the Conway Branch. The Newington and Portsmouth branches are candidates for fixed guideway transit systems. The candidate corridors for freight rail improvements include the five listed above plus the Pease Spur. (**Figure 1.2-3**).

Main Line West Corridor

The Main Line West Corridor is located north of the Newington–Dover Study Corridor. It is an active rail line that extends between Rollinsford and Plaistow for approximately 35 miles. This line is a through route between Maine and Massachusetts for both freight and passenger service.

Although this line is located along the northern edge of the study area, it is relevant to the study because of its potential to attract both intercity and commuter trips from the Newington–Dover corridor as well as the potential to attract freight traffic. The net result of either increased passenger rail or freight rail traffic along this line could be a reduction in auto trips along the Newington–Dover section of the Spaulding Turnpike.

Main Line East (Hampton Running Track) Corridor

The Main Line East is an active freight line that extends from the Portsmouth Line and Yard in Portsmouth to the Foss Manufacturing site in Hampton. This line is located south of the Newington–Dover Study Corridor. It is approximately 10 miles long and is currently used for freight service. Passenger service was discontinued in the late 1950's. South of Hampton the line is abandoned and owned by the state. Historically, the line continued into Massachusetts connecting across the Merrimack River in Newburyport to the MBTA's commuter rail network.

This corridor, located along the southern end of the study area, has the potential to host both commuter rail as well as improved freight rail services. The impact of either service however is likely to be negligible along the study corridor. In fact, a commuter rail service may actually generate additional auto trips along the study corridor by motorists driving to a station. Although a commuter rail service along this rail corridor may be an overall benefit to the public, it does not meet the purpose and need of this study.

Conway Branch Corridor

The Conway Branch is located north of the Newington–Dover Study Corridor. It extends from Rollinsford where it connects with the Main Line West to Conway, a distance of approximately 72 miles. There are two active segments and one inactive segment along the branch. The initial 42 miles of the branch extending from Rollinsford to Ossipee are owned and operated by the New Hampshire Northcoast Railroad (NHN). The middle section of the branch extending 24 miles from Ossipee to Conway has been inactive for a number of years. It was recently purchased by the

state. The last 6.5 miles of the branch, located in Conway, are owned and operated by the Conway Scenic Railroad (CSR), which runs a popular tourist train service over parts of this segment of the branch.

Although this line is located north of the study area, it is relevant to the study because of its potential to divert auto and truck trips from the Newington–Dover corridor. The line parallels Route 16 between Dover (Rollinsford) and Conway.

Newington Branch

The Newington Branch parallels the Spaulding Turnpike to the east, terminating at Bloody Point. It is an active freight line that extends between the town of Newington and the Portsmouth Branch in Portsmouth. This 3.5-mile branch historically formed the southern section of the rail line that connected Portsmouth with Dover. The line crossed from Bloody Point to Dover Point just east of the existing General Sullivan Bridge. The rail bridge across Little Bay was removed in 1934.

This corridor could serve two purposes: to provide expanded freight rail service or as a future location of a fixed guideway transit alignment. Increased freight rail service would be dependent on attracting new (or existing) businesses to receive and/or ship materials by rail.

Portsmouth Branch

The Portsmouth Branch is located south of the Newington–Dover Study Corridor. It is an active freight line that extends from Newfields on the Main Line West through the Portsmouth Yard to the Newington Branch. This 10-mile segment of track connects with the Main Line East at Portsmouth Yard. Historically, it was part of the B&M's Eastern Route Main Line that extended from Boston to Portland.

This corridor could serve two purposes: to provide expanded freight rail service or as a future location of a fixed guideway transit alignment. Increased freight rail service would be dependent on attracting new (or existing) businesses to receive and/or ship materials by rail.

Sawyer's/Dover Branches

The former Sawyer's Branch extended from the 2nd Street Yard in Dover on the Main Line West south to Sawyer's Mill on the Bellamy River, a distance of 1.5 miles. It was abandoned in the mid-1970's. The Dover Branch continued south of Sawyer's Mill to Dover Point. It was abandoned in 1941. Spur Road and a portion of the Spaulding Turnpike have been built over the former five-mile branch. There is little potential for rail transit use of this corridor.

Pease Spur

The former Pease Spur is located within the Newington–Dover Study Corridor. It extends from the Newington Branch into the Pease Tradeport. The initial 1.6 miles of

track is still in place but is out of service. The portion of the spur, which crosses the Spaulding Turnpike at grade, has been removed and paved over. Some of the track still exists on the Tradeport but is in poor condition. This corridor could provide expanded freight rail service to businesses located at the Tradeport. Increased freight rail service would be dependent on attracting new (or existing) businesses to receive and/or ship materials by rail.

■

2.4.2 Bus Service

Commuter bus service to Boston is currently provided by C&J Trailways along the Spaulding Turnpike and I-95 corridors. The service provides connections from Dover, Durham, and Portsmouth (as well as Newburyport) to Logan Airport and South Station in Boston.

Local bus service is provided by COAST and by the UNH Wildcat Transit. Five local bus routes are operated by COAST in Portsmouth, Dover, and the Rochester region. Wildcat Transit operates eight routes connecting the University of New Hampshire, Durham, Dover, Portsmouth and Newmarket.

As part of this study, consideration will be given to expanding or otherwise enhancing the current commuter and local bus service. Actions to be considered could include: additional service along the study corridor between Rochester, Dover and Portsmouth; additional park and ride lots offering traveler amenities; and overall coordination of the commuter bus service with other study area transit services.

■

2.4.3 Park and Ride Facilities

Another strategy to reduce demand on the Spaulding Turnpike is to facilitate ride-sharing through the availability of park and ride lots. Today there are no existing state (NHDOT supported) park and ride lots within the study area. However, nearby park and ride lots are located in Portsmouth and Hampton.

In addition to assessing how these existing facilities may be improved to increase utilization, potential new park and ride sites in Dover (in proximity to the Turnpike) and further north along the Turnpike will also be evaluated as part of this study. Potential park and ride locations will be reviewed in terms of size, availability, cost, access to and from the Turnpike, potential to be served by bus and rail, and environmental impacts. Additional amenities to be considered include provision for lighting, phones, bus shelters, rest rooms, information kiosks, bicycle lockers, and proximity to other commercial services. Park and ride lots in New Hampshire currently offer free parking, which provides a positive incentive to motorists to use them.

The study will also assess how ride-sharing may be increased through promotion by the Transportation Management Association (TMA) at the Pease Tradeport and by others such as the chambers of commerce in Dover and Portsmouth.

■

2.4.4 Bicycle/Pedestrian Transportation

State and local multi-use trails and bicycle routes traverse the study area with the General Sullivan Bridge currently providing the bicycle and pedestrian system connectivity between Durham and Dover to the north and Newington, Portsmouth and Greenland to the south. Corridor roadway and bridge upgrade alternatives will maintain the current system connectivity and provide a local Dover east-west grade separated connection for pedestrians and bicyclists between the two segments of Hilton Park which are currently bisected by the Turnpike. A similar east-west grade separated connection will be provided in Newington. In addition, the multi-use path adjacent to Pomeroy Cove connecting Hilton Park/Hilton Drive to Dover Point Road will be maintained.

2.5 Build Alternatives

Concepts for addressing existing and future travel demands for the Spaulding Turnpike corridor include adding travel lanes to the existing highway. Alternatives to be considered involve widening the existing highway and bridges from two lanes in each direction to either three or four lanes in each direction. Relative to the widening alternative, incorporation of high occupancy vehicle (HOV) lanes to serve immediate or future needs is a further consideration.

General use travel lanes on an important transportation facility such as the Spaulding Turnpike are typically 12 feet wide. In addition, shoulder widths are typically 10–12 feet wide on the outside (right hand) shoulder and 4-10 feet wide on the inside (left hand) shoulder.

In Newington, it is anticipated that the improved Turnpike mainline would be located within the existing vegetated median between Exit 3 and the Little Bay Bridges. This will allow construction of the expanded Turnpike while maintaining traffic on the existing separated mainlines. It should also afford space for improving interchange connections, while maximizing use of the existing Turnpike right-of-way and minimizing impacts to abutters and coastal marine resources.

In Dover, the Turnpike widening will need to be to the outside of the existing Turnpike since the median is already occupied by narrow shoulders and concrete barrier. The final Turnpike alignment in Dover will be influenced by controls such as the Little Bay Bridges and General Sullivan Bridge, Hilton Park, resource constraints

such as Pomeroy Cove located between Exits 5 and 6, construction phasing and traffic control requirements, and right-of-way impacts.

With respect to bridge considerations, the Little Bay Bridge alternatives will include:

- Widening/rehabilitating the existing bridges to provide 3 or 4 lanes in each direction;
- Rehabilitation of the existing bridges in concert with construction of a new bridge to collectively provide 3 or 4 lanes in each direction; or
- Replacement of the existing bridges with a new bridge to provide 3 or 4 lanes in each direction.

General Sullivan Bridge alternatives will include:

- Major rehabilitation for local traffic;
- Major rehabilitation for only bicyclists and pedestrians;
- Major rehabilitation for buses with provisions for bicyclists and pedestrians;
- Bridge replacement for local traffic and bicyclists and pedestrians;
- Bridge removal.

Current interchange configurations and connecting roads within the study area will be evaluated for possible design improvements to accommodate the widening, as appropriate, based on current AASHTO design standards. Consolidation of interchanges will be explored to reduce driver conflict points, improve access management, simplify the transportation roadway network and to minimize environmental and property impacts. New connections, such as a new north entrance to the Pease Tradeport, will also be considered.

High Occupancy Vehicle (HOV) Lanes

HOV facilities provide lanes dedicated to vehicles carrying more than one person. The number of people required per vehicle and the time periods the lanes are so dedicated are dependent on the demand for the lanes and are posted for driver compliance. To be successful, HOV lanes must not be congested or there will be little incentive for drivers of single occupancy vehicles (SOV) to consider ride-sharing or bus services. In addition, the HOV lanes must not be under-utilized, or motorists in general use lanes will question the merit of having HOV lanes. Possible HOV lane configurations include concurrent flow lanes and an exclusive reversible lane(s).

Whether HOV lanes should be constructed will require additional study. To construct and designate HOV lanes when general purpose lanes are not congested, runs the risk of having an under-utilized HOV lane that general purpose lane users may seek to use. To construct such a lane for future HOV use, but allow it to be used

as a general purpose lane in the meantime, runs the risk of not being able to convert it for HOV use, when HOV volumes and general lane congestion would warrant designation.

HOV facilities are typically incorporated into an existing highway corridor for which additional capacity is required, but further widening of the highway is not a likely option. HOV facilities are not typically constructed for highways with fewer than three lanes in each direction, as traffic volumes and occupancy rates are not high enough to support the lane usage required for a successful HOV facility.

Concurrent Flow Lanes

A concurrent flow HOV lane will be evaluated adjacent to the general purpose traffic lanes in each direction and would be located between the inside general purpose lanes and the median. The HOV lane would take the place of one of the additional travel lanes provided by widening the Turnpike (3 or 4 lanes). The HOV lanes are standard width lanes (12 feet) that may be physically separated from the general purpose traffic lanes (barrier separated) or may be delineated with paint striping (buffer separated). The recommended width of the buffer is 4 feet but can be reduced to 2 feet in areas of reduced right-of-way. The inside shoulder can range from an ideal of 14 feet (called an enforcement shoulder, as it provides room for police presence) to 10 feet (standard shoulder) to 2 feet for a reduced shoulder.

For barrier-separated lanes, the recommended separation is provided by a barrier and 12-foot shoulder between the barrier and the HOV lane. The shoulder can be reduced to 10 feet or to 8 feet in constricted areas. An inside shoulder of 4 feet is recommended but can be reduced to 2 feet.

The advantages of concurrent flow HOV lanes include:

- Lower construction cost.
- Lower operating cost.
- Direct or at-grade access is easy and inexpensive to implement.
- Can be designed to allow HOVs to enter or exit lane at any point.

The disadvantages of concurrent flow HOV lanes include:

- More difficulty enforcing HOV restrictions.
- Safety issues with direct or at-grade access because of different travel speeds of vehicles merging in the HOV lane or the adjacent travel lane and weaving between the HOV lane and exit or entrance ramps.

Reversible HOV Lane

A single or multiple exclusive reversible HOV lane would be physically separated from the general purpose lanes and would operate in the southbound direction during the weekday morning commute and in the northbound direction in the

evening. It may be used exclusively by HOVs for all or part of the day. The recommended cross-section includes a 12-foot travel lane(s) and 8-foot shoulders on both sides of the travel lane(s). Reduced cross-sections would allow for both shoulders to be four feet.

The advantages of exclusive, reversible lanes include:

- Easier enforcement of HOV restrictions.
- Fewer and better controlled access points reduce or eliminate conflicts between HOVs and non-HOVs.

The disadvantages of exclusive, reversible lanes include:

- More extensive right-of-way requirements.
- Higher construction costs to provide access to and from HOV lanes.
- Higher operating costs for staffing to manage reversing the direction of flow.

The feasibility for both concurrent and reversible HOV lanes, with respect to design, operations, access and right-of-way requirements, will be evaluated in concert with the development and evaluation of corridor upgrade alternatives, and strategies to reduce travel demand within the corridor.

3 Affected Environment

3.1 Topography, Geology and Soils

The study area lies geographically in what is referred to as the Seaboard Lowland section of the New England physiographic province, one of the subdivisions of the Appalachian Highlands (Fenneman 1938). Topography within the study area is gently rolling and most of the land lies between sea level and 60 feet above sea level. A small knoll rises to 100 feet in the southern one-third of the study area in Newington, near the Woodbury Avenue on-ramp to the Spaulding Turnpike. The highest point in the Dover portion of the study area lies at about 80 feet and is found at the northern project boundary.

The project lies within the Great Bay Drainage and Coastal Drainage watersheds which make up the larger Salmon Falls – Piscataqua Rivers drainage basin. The northern one-third of the study area contains portions of Little Bay and the Bellamy River that are tributary to the Piscataqua River which drains to the Atlantic Ocean. Other perennial watercourses that flow into the Piscataqua River in the Newington portion of the study area include from north to south, Pickering Brook, Railway Brook, and Flagstone Brook in the vicinity of Exit 4, Paul Brook south of Exit 3, and an unnamed stream near the southern extent of the study area.

Much of the present landscape character in the study area is the result of continental glaciation that ended between 10,000 and 14,000 years ago during the Pleistocene Epoch. As the glacier moved from the northwest to southeast, it scoured and smoothed the underlying bedrock, picking up soil, rock, and other debris. These materials were later deposited as glacial drift when the ice sheet melted. As a result, geologic formations throughout the study area contain exposed bedrock, stratified and unstratified glacial drift, and marine deposits.

Bedrock geology underlying the study area consists of Devonian and Silurian metamorphic rock. The Devonian rock is made up of slate, phyllite, aluminous schist, local calc-silicate granofels, and bimodal metavolcanic rocks. The Silurian rock is aluminous schist, quartzite, calc-silicate granofels, and bimodal metavolcanic rocks.

Soils series as described in the soil survey maps produced by the Natural Resource Conservation Service (NRCS) for Rockingham County and Strafford County were each grouped into the categories based on predominant parent material or land-use. Five

major soil categories were identified in the study area (**Figure 3.1-1)**. The major parent material or land use categories are:

- Marine/Lacustrine
- Till
- Glaciofluvial
- Anthropogenic
- Organic Material

Soils derived from marine deposits are the most common type identified within the Spaulding Turnpike study area. Marine/lacustrine soils are deep (20 to 50 inches), moderately well drained to very poorly drained fine sand and silt materials deposited in the isostatic depression of the earth's crust as ocean waters inundated upland areas following glaciation. Marine soils are spread uniformly throughout the study area and are interspersed with areas of coarse materials deposited from melt waters during the last glacial retreat. Marine soils comprise approximately 50 percent of the study area.

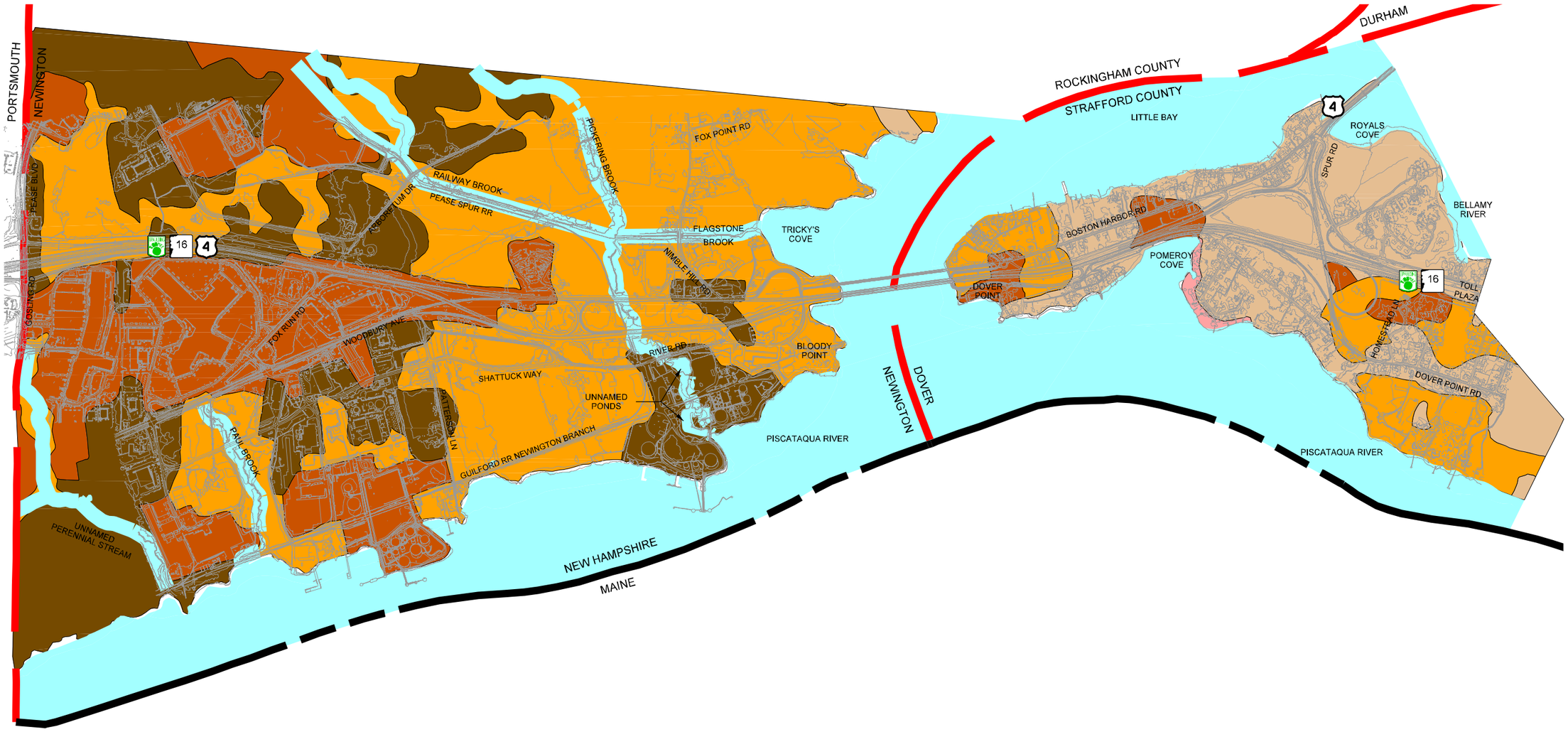
Till soils generally consist of an unstratified, heterogenous mixture of clay, silt, sand, gravel, and boulders, which were deposited directly by glacial ice with little or no transportation by water. In the study area, till consists of moderately deep (20 to 40 inches), well drained, very fine sandy loam subglacial stream deposits occurring in Newington in the southern portion of the study area. Glacial till soils cover 25 percent of the study area.

Glaciofluvial soils consist of very deep, somewhat excessively drained, gravelly fine sandy loam soils formed in stratified glaciofluvial drift. Glaciofluvial soils are commonly associated with kame terraces, eskers, and deltas deposited from subglacial streams and meltwaters. Glaciofluvial soils occur in small deposits north of Nimble Hill Road, near the western study area boundary and west of the General Sullivan Bridge in Newington. Glaciofluvial soils cover approximately 5 percent of the study area.

Anthropogenic soil (urban or "made land") includes any areas identified in the soil series maps that consist mainly of sandy or gravelly fill material that has been placed on terraces, floodplains, and uplands. The amount of fill that may have been placed varies from 20 inches to 20 feet. Similarly, urban or made land also includes any areas where 85 percent or more of the land area is covered with buildings, asphalt or concrete. Typically, these areas include business districts, industrial parks and shopping centers. Anthropogenic soils make up approximately 20 percent of the study area, and are particularly common in the southeast portion of the study area.

Organic soils are made of material that accumulates in wet places where plant materials are deposited more rapidly than they decompose. These deposits are referred to as peat, which is made of varying vegetative materials to 50 inches deep, and can include layers of mineral materials. Within the study area, organic soils are

New Hampshire DOT
Department of Transportation



Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- MARINE/LACUSTRINE
- GLACLOFLUVIAL
- ANTHROPOGENIC
- ORGANIC MATERIAL
- TILL

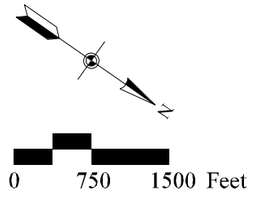


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Figure 3.1-1
Major Soil Associations

limited to an area comprising less than one percent, found northerly adjacent to Pomeroy Cove in Dover.

3.2 Surface Water Resources

The following sections describe surface water resources located within the Spaulding Turnpike study area. The study area contains five perennial freshwater streams (Pickering Brook, Paul Brook, Flagstone Brook, Railway Brook, and an unnamed perennial stream), as well as two small unnamed ponds. These freshwater resources are located within the Newington portion of the study area. Perhaps the most notable feature of the study area, however, is the Great Bay estuary, a tidally-influenced waterway consisting of the Great Bay, Little Bay, their tributaries and the Piscataqua River. The study area includes large portions of Little Bay and the Piscataqua River, as well as portions of the Bellamy River. As discussed below, these surface waters contain a variety of natural resources.

■

3.2.1 Regulatory Overview

Surface water quality regulations are administered by the New Hampshire Department of Environmental Services, Water Supply and Pollution Control Division. Water Quality Standards classify waters as A or B and designate uses and water quality criteria for each class. Class A is the highest classification and designates water quality that is uniformly excellent and potentially acceptable for water supply uses, after adequate treatment. Discharge of sewage or waste into Class A waters is prohibited. Class B waters are considered acceptable for swimming, fishing, and after adequate treatment, water supplies. All surface waters within the study area are Class B (K. Edwardson, NHDES, pers. com.). Based on the applicable water quality classification of the receiving waters, NHDES regulates discharges to surface waters to ensure that such discharges do not bring water quality below the physical, biological and chemical parameters established for the water quality class. Additionally, under Section 401 of the Clean Water Act, the NHDES must certify that federal actions (*i.e.*, FHWA funding or ACOE permitting) comply with the state water quality standards. As discussed in Sections 3.2.6 and 3.2.7 below, Federal and State law can provide additional regulatory protection through the National Wild and Scenic Rivers Program, the NH Rivers Management program, and under the Magnuson-Stevens Act.

■

3.2.2 Watersheds

As shown on **Figure 3.2-1**, the study area includes three principal sub-watersheds associated with the Bellamy River, Coastal Drainage, and Great Bay. All three

systems are part of the larger Piscataqua River Basin which empties into the Atlantic Ocean. The eastern portion and bulk of the southern portion of the study area are contained within the Coastal Drainage watershed. The northwestern portion is within the Bellamy River watershed and the west-central portion of the study area is within the Great Bay watershed. Smaller drainage basins associated with Pickering Brook, Railway Brook, Flagstone Brook, Paul Brook, and an unnamed perennial stream, are located in Newington and lie within the Piscataqua River watershed. The following sections provide a detailed description of these individual resources.

■

3.2.3 Lakes and Ponds

There are no lakes or great ponds located within the study area, although two small unnamed ponds are found in Newington (see **Figure 3.2-1**), although the upper pond is now more appropriately treated as a wetland. Both are located along Pickering Brook northeast of Exit 4 and east of River Road. Pickering Brook flows eastward beneath Spaulding Turnpike, connecting the two ponds under the existing railway. The two ponds have a combined surface area of approximately 3 acres, with the easterly (lower) pond mapped as tidally-influenced by the National Wetlands Inventory (NWI). Over recent years the westerly (upper) pond has aged and succeeded towards a palustrine emergent wetland (see discussion in Wetlands Section 3.6). Approximately 3,000 feet of the northbound and southbound lanes of Spaulding Turnpike and River Road lie within the watershed of the ponds. Much of the roadway runoff flows to adjacent upland areas or into Pickering Brook prior to entering the ponds. The two ponds are classified as Class B waters and provide aquatic and terrestrial wildlife habitat value.

■

3.2.4 Rivers, Streams, and Tributaries

Five perennial streams and tributaries are located within the study area in Newington. The streams discharge to Little Bay and the Piscataqua River and are described in more detail below. There are no perennial watercourses within the study area in Dover. (See **Figure 3.2-1**.)

Piscataqua River

The Piscataqua River is part of the larger Salmon Falls/Piscataqua River Basin which includes approximately 1,356 square miles in New Hampshire and Maine. The river flows south along the east side of the study area and is the largest river within the study area, with a total length of approximately 8.5 miles and an estimated watershed area of 758 square miles. The Piscataqua River is formed by the confluence of the Cocheco and Salmon Falls Rivers approximately 12 miles north of the study area. Within the study area, the Piscataqua River is a tidally-influenced channel which is typically 2,000 to 3,500 feet wide with a substrate composition of sand and mud throughout. Various small tributaries discharge cool oxygenated water into the Piscataqua River from the surrounding uplands. Adjacent land use consists of

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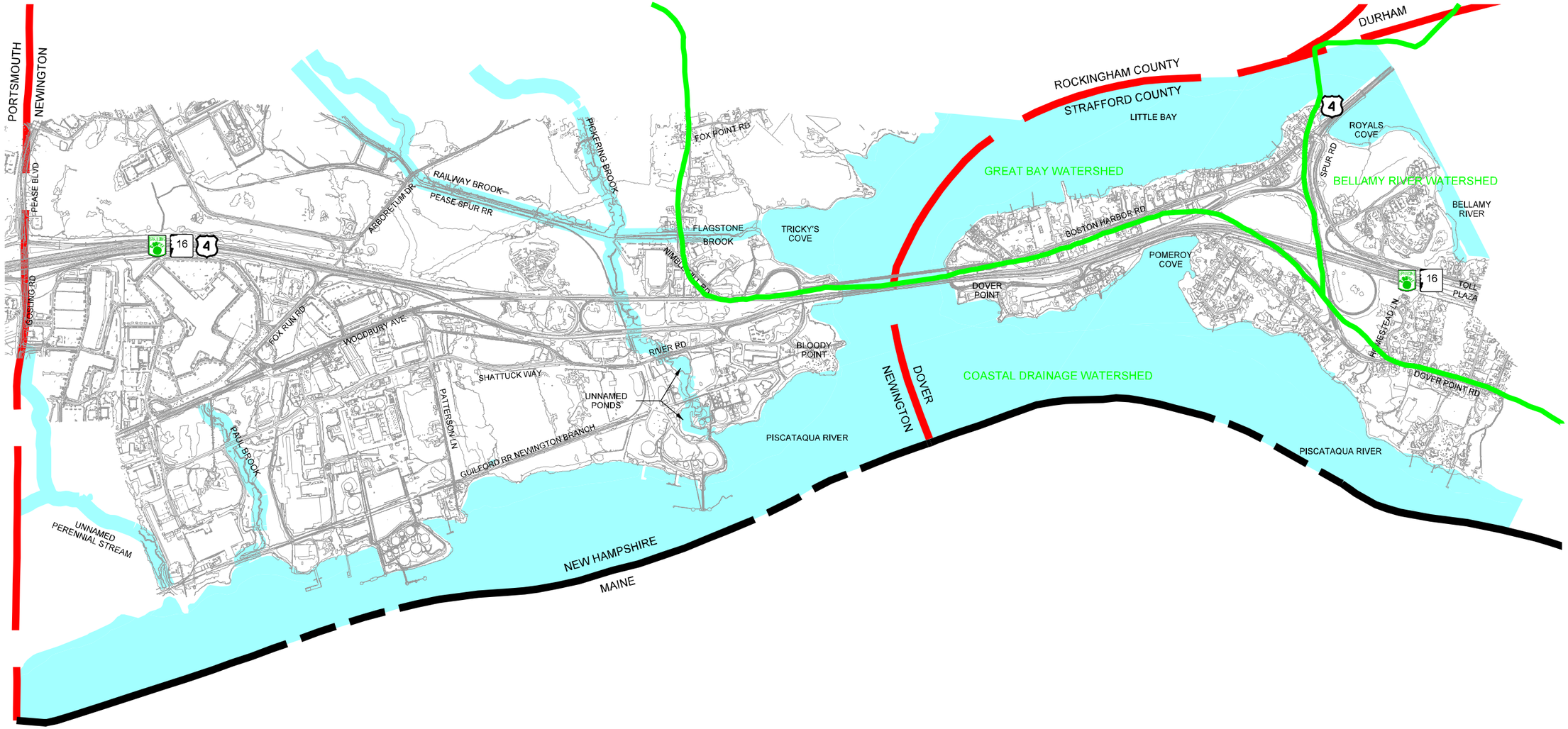

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- WATERSHED BOUNDARY

0 750 1500 Feet

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Figure 3.2-1
Watersheds and Surface
Water Resources

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residential/commercial development, forested upland, and vegetated wetland habitats. Within the study area, the Piscataqua River supports striped bass (*Morone saxatilis*), bluefish (*Pomatus saltatrix*), winter flounder (*Pleuronectes americanus*), and herring (*Clupea* spp.).

Bellamy River

The Bellamy River flows south through Dover along the west side of the study area and is the second largest river within the study area having a total length of approximately 8 miles (from the Bellamy Reservoir) and an estimated watershed area of 34 square miles. The Bellamy River is classified as a Class B waterway below the Bellamy Park Dam in Dover. Within the study area, the Bellamy River is tidally-influenced and is typically 1,000 to 1,200 feet wide with a substrate composition of sand and mud throughout. Various small tributaries discharge cool oxygenated water into the Bellamy River from the surrounding uplands. Adjacent land use consists of residential/commercial development, forested upland, and vegetated wetland habitats.

Little Bay

Little Bay is a tidally-influenced waterway west of the study area that receives flow from the Piscataqua River to the east; the Bellamy River to the north; the Oyster River to the west; and Great Bay to the south. Little Bay is within the Great Bay watershed which has a total watershed area of approximately 112 square miles. Little Bay is approximately 3 square miles in size upstream of its confluence with the Piscataqua River. The substrate composition is sand and mud throughout.

Railway Brook

Railway Brook is a perennial channelized watercourse (within Newington), which flows parallel to a portion of an historic rail grade located between 800 and 1,200 feet west of the highway. The predominantly straight channel is rip-rapped and impounded with various flood control structures for much of its length as it carries stormwater runoff and drainage from its point of origin at the Pease International Tradeport to the confluence with Pickering Brook and Flagstone Brook, approximately 1 mile to the north. Portions of the brook contain heavy sediment loads and a silt/muck substrate, while other swifter-moving stretches have a cobble/gravel streambed (nearer the confluence). The stream has very densely vegetated banks and scrub-shrub wetland plant communities for most of its length. Portions of the stream flow through areas with commercial and residential development, including former landfill areas. Water quality in Railway Brook is impaired, and does not support aquatic life or consumption of fish [NHDES 305(b)/303(d) Surface Water Quality Assessment 2002].

Pickering Brook/Flagstone Brook

Pickering Brook drains a series of emergent and forested wetlands located near the center of the study area in Newington and areas north and west of the Pease

International Tradeport outside of the study area. The perennial stream meets its tributary, Railway Brook, approximately 900 feet south of the culverts at Nimble Hill Road. A berm directs a portion of Pickering Brook's flow northward to Flagstone Brook, which discharges to Tricky's Cove. Before its flow was diverted into Flagstone Brook, Pickering Brook appears to have flowed in its entirety eastward, beneath the Spaulding Turnpike, under River Road and through the Sprague Energy property before discharging into the Piscataqua River. Under current conditions, only a portion of Pickering Brook continues to flow in this direction. Portions of the stream flow through areas altered by dense commercial and residential development, including former landfill areas. Like other streams in the area, water quality in Pickering Brook is impaired and does not currently support aquatic life or consumption of fish [NHDES 305(b)/303(d) Surface Water Quality Assessment 2002].

Paul Brook

Paul Brook is a perennial stream east of Woodbury Avenue in Newington. The stream flows east to its convergence with the Piscataqua River. The eastern end of Paul Brook is tidally-influenced providing estuarine emergent vegetated habitats. The western portion of Paul Brook supports palustrine scrub-shrub and emergent vegetation communities along its riparian zone. Paul Brook is a Class B waterway, although surrounding land use consisting largely of industrial and commercial development has likely caused impairment to the stream which is does not currently support aquatic life or consumption of fish (NHDES 305(b)/303(d) Surface Water Quality Assessment 2002).

Unnamed Tributary to the Piscataqua River

An unnamed perennial tributary to the Piscataqua River is located east of the Spaulding Turnpike at the south end of the study area in Newington. The stream has two branches, one that flows east under Woodbury Avenue, north of and parallel to Gosling Road, and a second branch that flows northeast under Gosling Road east of Woodbury Avenue. The two branches converge just north of the Gosling Road/Woodbury Avenue intersection. The stream then flows northeast to its confluence with the Piscataqua River within the industrial area of Newington.

■

3.2.5 Aquatic Life

Within the study area, the Piscataqua River and Little Bay are tidally-influenced and capable of supporting fish species such as striped bass *(Morone saxatilis)*, bluefish *(Pomatomus saltatrix),* winter flounder *(Pleuronectes americanus),* and herring (*Clupea* spp.). These waterways also support crustaceans such as green crab (*Carcinus maenas*), Asian shore crab (*Hemigrapsus sanguineus*) and American lobster (*Homarus americanus*); shellfish such as Atlantic ribbed mussel (*Geukensia demissa*); and macroinvertebrates such as marine worms (*Neris* sp.) and species of periwinkle (*Littorina* spp). Essential Fish Habitat as designated by National Marine Fisheries Service (NMFS) is present in

the study area as presented in Section 3.2.7, and a detailed description of marine habitats is discussed in Section 3.2.8.

No formal habitat/species inventory of the freshwater ponds and streams in the study area has been conducted, nor is any published data available for these resources. However, based on an informal assessment of habitat types associated with the freshwater resources listed above, it is expected that only common warm water species would be found within the perennial streams and ponds in the study area. This habitat type on New Hampshire's seacoast would typically contain species such as pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ictalurus nebulosus*), white sucker (*Catostomus commersoni*), and black crappie (*Pomoxis nigromaculatus*).

■

3.2.6 Wild and Scenic, or NH Designated Rivers

There are no rivers, brooks, or streams in the study area either under study or currently listed with the National Wild and Scenic Rivers Program. None of the rivers, brooks or streams in the study area are under study for protection, or are currently designated as natural, rural, or community rivers within the New Hampshire Rivers Management and Protection Program under RSA 483.

■

3.2.7 Essential Fish Habitat

The following sections provide a description of pertinent regulations and methodologies used to present data, and a summary of findings from review of fish habitat information and data.

The Magnuson Fishery Conservation and Management Act (MSA) of 1976 (since renamed the Magnuson-Stevens Act), established a requirement to describe and identify "essential fish habitat" (EFH) in each Federal Fishery Management Plan. EFH is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical, and biological properties. Additionally, many species of fish in the study area are protected by interstate management plans administered by the Atlantic States Marine Fisheries Commission (ASMFC). The Commission's Interstate Fisheries Management Program (ISFMP) began in 1981, with the signing of a cooperative agreement with the NMFS. The ISFMP built upon the experiences of the cooperative State/Federal Fisheries Management Program, which started in 1971, and the Regional Fishery Management Council system, which was established under the Magnuson-Stevens Fishery Conservation and Management Act. Fishery Management Councils determine which areas will be designated as EFH. The MSA requires all federal agencies to consult with the NMFS on all proposed federal actions that may adversely affect EFH.

For this report, the NOAA website was reviewed to obtain a list of species likely to be found within the study area. To facilitate the EFH consultation process, an on-line guide provides a quick method of ascertaining what species and life stages have EFH in a given geographic area. The information is presented in tabular summaries for selected 10 minute by 10 minute squares of latitude and longitude. The study area EFH species are shown in Table 3.2-1. NMFS also provided a list of EFH species in its letter to FHWA outlining their participation as a cooperating agency and as described below in Section 3.2.7.3.[12] A copy of NMFS letter is included in Appendix B of this report. In addition, NHF&GD was contacted to request a review of existing records of species expected to be found within the study area. Section 3.2.7.3 lists NHF&GD recommendations with regard to EFH and species likely to be found within the study area[13].

As shown in Table 3.2-1 below, waters in the study area have been identified as EFH for 17 species of fish by NOAA. Temperature, salinity, dissolved oxygen, water depth, substrate composition, and bathymetry are among the factors defining EFH for specific species. These factors influence the presence or absence of individual fish species within a given area of EFH.

Table 3.2-1
Essential Fish Habitat Species in the Study Area

Species	Eggs	Larvae	Juveniles	Adults
Atlantic Salmon *(Salmo salar)*			X	X
Atlantic Cod *(Gadus morhua)*	X	X	X	X
Haddock *(Melanogrammus aeglefinus)*	X	X		
Pollock *(Pollachius virens)*	X	X	X	X
Whiting *(Merluccius bilinearis)*			X	X
Red hake *(Urophycis chuss)*	X	X	X	X
White hake *(Urophycis tenuis)*	X	X	X	X
Winter flounder *(Pleuronectes americanus)*	X	X	X	X
Yellowtail flounder *(Pleuronectes ferruginea)*		X		X
Windowpane flounder *(Scopthalmus aquosus)*	X	X	X	X
American plaice *(Hippoglossoides platessoides)*				X
Atlantic halibut *(Hippoglossus hippoglossus)*	X	X	X	X
Atlantic sea scallop *(Placopecten magellanicus)*	X	X	X	X
Atlantic sea herring *(Clupea harengus)*		X	X	X
Bluefish *(Pomatomus saltatrix)*			X	X
Atlantic mackerel *(Scomber scombrus)*	X	X	X	
Bluefin tuna *(Thunnus thynnus)*				X

Source: National Marine Fisheries Service. "Summary of Essential Fish Habitat (EFH) Designation" posted on the internet at http://www.nero.noaa.gov/ro/STATES4/Gulf_of_Maine_3_western_part/43007040.html

[12] Patricia A. Kurkul, Regional Administrator, NMFS. Letter to Kathleen O. Laffey, Division Administrator, FHWA. July 17, 2003.

[13] Bruce Smith, NHF&GD. pers. com. December 31, 2003.

Correspondence with NMFS indicated that the proposed study area borders and includes areas identified as EFH for life history stages of several species managed by the New England Fishery Management Council and NOAA Fisheries. These species include: the eggs and larvae of Atlantic cod and haddock; larvae, juvenile and adult Atlantic herring; juvenile and adult Atlantic salmon, red hake, whiting and Atlantic sea scallops; eggs, larvae, and juvenile pollock; eggs, juvenile and adult white hake; and all life history stages of windowpane, yellowtail, and winter flounder. In addition, the area is know to support a number of NOAA Fisheries trust resources, such as soft-shell clams, blue mussels, American lobster, tomcod, rainbow smelt, American shad, blueback herring, Atlantic silverside, striped bass and eelgrass.

Recommendations by NHF&GD include the deletion of certain species of fish and/or specific life stages and inclusion of others due to the lack of (or presence of) specific data or evidence. More specifically, NHF&GD indicated that study area waters would not support the following: adult whiting, yellowtail flounder, American plaice, Atlantic sea herring, and bluefin tuna; and juvenile and adult halibut. NHF&GD indicated that the study area waters would be expected to support: larvae of grey sole; juvenile and adult butterfish; and adult summer flounder and mackerel. In addition to species protected under Federal Fishery Management Plans, several species are also protected under ASMFC management plans. These four species include: juvenile and adult menhaden, blueback herring, and alewife; and larvae, juvenile and adult smelt.
As the project design elements are further defined, specific potential impacts (if any) to EFH will be determined. A full assessment of potential impacts to EFH will be contained within the Draft EIS.

■

3.2.8 Marine Environment

A study of marine intertidal and subtidal bottom types was conducted during the summer of 2003 in an effort to better understand the key marine habitat elements in the vicinity of the Newington-Dover project. These investigations were limited to areas of potential direct impacts, and included a corridor 600 feet wide centered on the existing Little Bay Bridges, as well as Pomeroy Cove east of Dover Point.

Habitats were preliminarily mapped directly from the 2002 aerial imagery and color infrared imagery taken at low tide during 1990 and 1991. Preliminary maps were ground-truthed by field inspection on three different days with differential GPS (DGPS). Subtidal maps were constructed based on a composite, geo-referenced bathymetric map consisting of 1953 data from the entire study area under and near the bridges combined with high resolution multibeam sonar data collected in 2001 from the 18-foot contour line (below sea level) and deeper. Subtidal bottom types and habitat types were based on underwater videography along pre-determined transect lines using a towed video system with recording DGPS.

The intertidal bottom types and habitat types map (**Figure 3.2-2)** is based on geo-referenced, low-altitude aerial imagery with sub-meter resolution and accuracy. The boundaries between most bottom types and habitat types were readily discernable from the imagery and both study areas were inspected with nearly 100 percent coverage on three separate field trips.

The subtidal bottom type map and habitat type map were mainly derived from underwater videography. In some cases, the bathymetric data were used to estimate boundaries between bottom and/or habitat types.

Pomeroy Cove

Pomeroy Cove is a soft-sediment environment consisting of a large intertidal mudflat surrounded by peaty deposits with associated salt marsh habitat.

Intertidal habitats in Pomeroy Cove were grouped and mapped by two major types: salt marsh and unvegetated mudflat. Salt marsh habitat is dominated by cord grass (*Spartina* spp.) and includes other plants such as sedges (*Carex* and *Scirpus* spp.), spike grass (*Distichlis spicata*), spike-rushes (*Eleocharis* spp.), rush (*Juncus* spp.), and glasswort (*Salicornia* spp.). Invertebrates such as common periwinkle (*Littorina littorea*), Atlantic ribbed mussel, green crab, and amphipods (*Gammarus* spp.) are present. Fish species such as mummichog (*Fundulus heteroclitus*), silverside (*Menidia menidia*), and stickleback (*Gasterosteus* spp.) are also present in areas of salt marsh. Intertidal mudflats in many areas of the Great Bay/Piscataqua River estuarine system are "potential habitat" for soft shell clams (*Mya arenaria*). For the present study, a map based on information in Banner and Hayes (1996), as well as input from NHF&GD and Jackson Estuarine Lab at UNH was provided by the NHDES. It should be noted that no shellfish (oysters or clams) were observed in the present study areas, but more extensive surveys than were conducted would be needed to adequately assess their distribution.

Little Bay and General Sullivan Bridges Area

The study area near the bridges has a wide diversity of bottom types and habitat types, and includes intertidal and subtidal areas. For the overall area, nine different bottom types were mapped: intertidal hard bottom with rockweed; intertidal mudflat, intertidal rock/algal/abundant mussel; intertidal rock/algal/soft sparse mussel; intertidal saltmarsh; intertidal scattered rock/algal/soft sediment; subtidal kelp bed; subtidal macroalgal (non-kelp) bed; and subtidal mussel reef (**Figure 3.2-2**).

Intertidal areas near the bridges consist of peaty deposits in several areas, expansive unvegetated mudflats, and rocky bottoms with scattered patches of soft sediments. Subtidal areas consist mainly of rocky bottom types ranging from small gravel to large boulders interspersed with widely scattered patches of soft sediments. Discussion of these bottom types is incorporated into the discussion of habitat types below.

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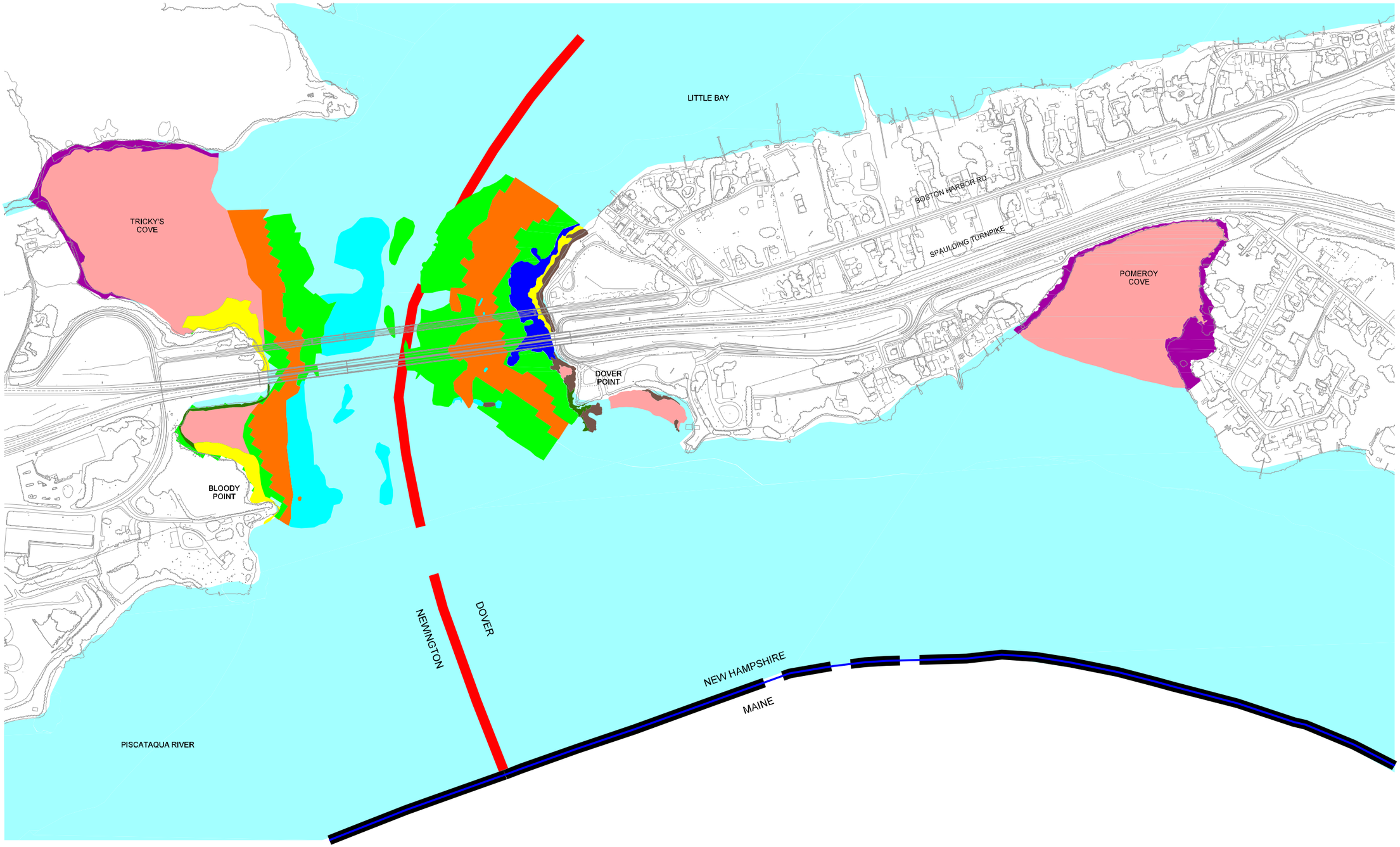

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE

INTERTIDAL HABITATS

- HARD BOTTOM WITH ROCKWEED
- MUDFLAT
- ROCK / ALGAL / ABUNDANT MUSSEL
- ROCK / ALGAL / SPARSE MUSSEL
- SALT MARSH
- SCATTERED ROCK / ALGAL / SOFT SEDIMENT

SUBTIDAL HABITATS

- KELP BED
- MACROALGAL (NON-KELP) BED
- MUSSEL BED

0 250 500 Feet

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Figure 3.2-2
Intertidal & Subtidal Habitats

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Intertidal habitats near the bridges were grouped and mapped by six major types: hard bottom with rockweed; mudflat; rock/algal/abundant mussel; rock/algal/soft sparse mussel; saltmarsh; and scattered rock/algal/soft sediment. Salt marsh is restricted to the intertidal zone, forming a narrow fringe along Tricky's Cove. Field inspection of the areas under and on both sides of the existing bridges indicates that there is some narrow fringe salt marsh in some places, although this fringe is sometimes only a few feet wide in the immediate vicinity of the bridges.

Salt marsh habitat is dominated by cord grass and includes similar species of plants, invertebrates and fish indicated for salt marsh areas in Pomeroy Cove (discussed above). Intertidal mudflats are relatively narrow and only occur in two areas east of the bridges on the Dover Point (north) side. In contrast, there are expansive mudflats on both sides of the bridges on the Newington (south) side. All intertidal mudflat habitat is at least potential clam habitat, and as already noted, further inspection of these areas might be needed, depending upon the alternatives that will be assessed. With the exception of a few scattered patches of soft-sediment deposits, the remaining intertidal habitats near the bridges are all on rocky bottoms, and vary mainly by the presence or absence of rockweeds and mussels. These habitats grade into similar habitat types subtidally.

Subtidal habitats near the bridges are all predominantly hard bottom, ranging from gravel to boulders. This area is a tidal rapid which regularly experiences tidal currents up to approximately 10 feet/second on spring tides. Hence, the organisms must be adapted for high-flow conditions, or live in micro-environments (*e.g.*, patches of soft sediment in a few areas) protected from the currents. All three of the mapped habitat types are ecologically quite diverse and apparently (based on numbers of epibenthic organisms observed) very productive. Of particular note in this respect are the kelp beds (dominated by *Laminaria* spp.) and mussel beds.

■

3.2.9 Hydrodynamics and Navigation

The University of New Hampshire Ocean Engineering is developing a hydrodynamic model of the Great Bay/Piscataqua River Estuarine System to predict currents in the area of the Little Bay and General Sullivan Bridges and to show what effects changes to the bridge pier system would have on currents in the area. Physical measurement of currents in the vicinity of the bridges were conducted by the University of New Hampshire in the summer of 1975 in cooperation with the National Ocean Survey (NOS) and reported in a paper by Swift and Brown (1983). They reported that river currents appear to be nearly uniform with depth and have magnitudes that are sensitive to local channel cross-section area. Data published in their paper show that the currents in the area of the Little Bay Bridges are on the order of 10 feet per second at maximum values during both the ebb and flood tides, with the ebb values slightly greater than the flood values.

The Piscataqua River channel provides important navigation access to Great Bay from the open ocean. A portion of the Piscataqua River federally-maintained navigation project is located within the study area. The federal project is a 35-foot deep, 400-foot wide channel which extends from deep water in Portsmouth Harbor to about 1,700 feet upstream of the Sprague Energy Terminal Corporation wharf in Newington. An 850-foot wide, 35-foot deep turning basin is situated at the head of the project. A project to dredge the channel is currently being studied by the USACOE. The center line of the navigation project defines a portion of the New Hampshire/Maine state boundary.

While the federal project accommodates larger vessels, navigation is limited largely to smaller recreational craft beyond the upstream limit of the channel, *i.e.*, beneath the General Sullivan and Little Bay bridges and toward Little Bay. In this vicinity, where the Piscataqua River meets Little Bay, the waters are characterized as tidal rapids. As discussed above, current velocities increase to as much as 10 feet per second due to flow constrictions caused by Dover Point and Bloody Point. Potential continued deterioration of General Sullivan Bridge as a threat to safe navigation beneath the bridge is a concern of the USCG. (USCG, pers. com., November 21, December 1, and December 15, 2003). More information on hydrodynamics and navigation in the study area will be obtained during development of the EIS for the project.

3.3 Floodplains

■

3.3.1 Regulatory Overview

All federal projects potentially impacting floodplains require an evaluation under Executive Order 11988, Floodplain Management (May 24, 1977). The regulations that set forth the policy and procedures of this order is entitled Floodplain Management and Protection of Wetlands (44 CFR §9), which is under the authority of the Federal Emergency Management Agency (FEMA). FHWA policies and procedures also cover the impact of projects on floodplains and floodways, and are found in Location and Design of Encroachments on Floodplains (23 CFR 650A).

A 100-year floodplain is defined as having a one percent annual chance of flooding and typically is the minimum level of flooding used in floodplain management regulations. Floodplain refers to "the lowland and relatively flat areas adjoining inland and coastal waters including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year" (44 CFR §9). Factors which cause or contribute to flooding include drainage area characteristics (*i.e.,* topography), storm patterns, antecedent moisture conditions, time of year, and channel obstructions.

The Regulatory Floodway is generally defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base

flood without cumulatively increasing the water surface elevation more than one foot at any point. Along watercourses that do not have a designated Regulatory Floodway, no encroachment is permitted within specified zones on each community's Flood Insurance Rate Map (FIRM), unless the applicant demonstrates that the cumulative effect of the proposed development, when combined with all existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point in the community.

The City of Dover Code for Floodplain Development (Chapter 113) recognizes floodplain elevations as those delineated in the FEMA Flood Insurance Study (FIS), dated April 15, 1980, with the accompanying series of FIRMs and Flood Boundary – Floodway Maps. The Code prohibits building, encroachment, or other development within the floodplain along watercourses that have been designated as Regulatory Floodways. For watercourses not designated as Regulatory Floodways, the City of Dover permits development if it is demonstrated that such development will not increase the base flood elevation more than one-foot at any point within the community.

The Town of Newington does not have a specific town ordinance regulating development within floodplains and floodways. The town does, as a matter of policy, prohibit building within the floodplain. However, Newington does not rely on available 1975 Housing and Urban Development Flood Insurance Area (HUD FIA) Flood Hazard Boundary Maps (no FEMA FIRM Maps are currently available for Newington) for 100-year floodplain elevations within town boundaries, but rather considers flood elevations calculated during preparation of the FISs for adjacent towns as accurate (Town of Newington Website and Tom Morgan, Town Planner, pers. com., December 3, 2003). Interpolating the elevation of the Special Flood Hazard Area (SFHA) shown on 1975 HUD Maps for Newington by overlaying over current USGS Maps produces flood elevations that would be significantly higher than indicated in FIRM Maps for adjacent towns of Portsmouth, Dover, Durham and Exeter. The 1975 HUD maps were prepared primarily to identify properties in a community that are eligible for flood insurance and were often based on approximate methods of flood boundary determination, which may have produced these discrepancies in elevations.

■

3.3.2 Methodology and Summary of Findings

To determine floodplain elevations in the study area, FIS and FIRM data was collected for the municipalities of Portsmouth (1981 & 1982), Durham (May 3, 1990), Exeter (1981 & 1982) and Dover (1980), as these towns have boundaries along the Piscataqua River, Bellamy River, Little Bay and the Squamscott River. Based on these data, Base Flood Elevations of tidal waters within the study area are generally between 7 and 9 feet NGVD 29. As mentioned above, the 1975 HUD Map for Newington indicates the SFHA elevation to be significantly higher (approximately el. 20). Given that the more recent FIS and FIRM data for adjacent communities were based on detailed methods of

hydrologic analyses as defined by FEMA, these data should be considered accurate for flood determination.

The most severe flooding of coastal areas in New England is caused primarily by storm surges generated by coastal storms referred to as "Northeasters." Flood elevations provided in FIS and FIRM Maps for the communities of Portsmouth, Dover, Durham and Exeter are based on still water elevations and include tidal and wind setup effects. The effects of wave crest height and wave run-up are not considered in the determination of flood elevations. "Coastal structures that are located above still water elevations can still be severely damaged by breaking wave forces, wave run-up, wave erosion, and wave-borne debris."[14]

As the location of the 100-year floodplain varies between Newington and surrounding communities, it is recommended that more information on the 1975 HUD study for Newington be collected to determine if this study was based on approximate methods for determining SFHA. Preparing an updated flood study for Newington that is based on information available from more recent FISs from adjacent communities would likely be warranted. Since floodplain data and mapping within the study area is conflicting, floodplain data is not presented graphically or in the text of this Scoping Report. The floodplain issue requires further study and will be resolved during development of DEIS for the project.

3.4 Groundwater Resources

■

3.4.1 Regulatory Overview

Important groundwater resources within the study area consist of stratified-drift aquifers, and the municipal, community, and private supply wells that pump water from them. These groundwater resources are regulated under the New Hampshire Groundwater Protection Act, 1991 (NHGPA), which empowers local municipalities to regulate land uses in certain cases.

■

3.4.2 Methodology

A review of NH GRANIT layers was conducted to determine the location of aquifers, water wells, and wellhead protection areas (WHPA) within the study area. These electronic files were merged with the project base map to create the water resources map **(Figure 3.4-1)**.

▼

[14] FIS City of Portsmouth, NH November 17, 1981 (pg. 7)

■

3.4.3 Summary of Findings

The most productive aquifers in the study area are composed of stratified-drift deposits as depicted in **Figure 3.4-1**. The potential yields of groundwater from areas within each aquifer are mapped by NH GRANIT according to transmissivity values. Transmissivity is measured in square feet per day and quantifies the ability of an aquifer to transmit water. Aquifer transmissivity is broken down into four categories: 4,000–8,000 sq ft/day; 2,000-4,000 sq ft/day; 1,000–2,000 sq ft/day; and 1–1,000 sq ft/day. Groundwater within the study area is currently classified as GA2, the default classification for areas of known stratified drift deposits.

Notable within the study area is a large glacial stratified-drift aquifer that occurs under the entire northern portion of the study area in Dover. The majority of this aquifer is mapped with a transmissivity value of 1,000 to 2,000 sq ft/day, relatively low for a stratified drift formation. Smaller portions of this aquifer directly north of Pomeroy Cove have higher transmissivity values, with potentials of 2,000 to 4,000 and 4,000 to 8,000 sq ft/per day. A stratified-drift aquifer also occurs along the western side of the Newington portion of the study area and is mapped by NH GRANIT with a relatively low transmissivity value of 1 to 1,000 sq ft/day.

Bedrock aquifers contain water available to wells only in fractures in the otherwise crystalline rock. Although bedrock aquifers currently serve as private and public water supplies, variation in the density and location of water-bearing fractures make methodical prospecting for large production wells difficult. According to a review of existing geological mapping and consultations with the NHDES, no high yield bedrock aquifers occur within the study area.

Two private water wells occur in Dover within the northeast portion of the study area as depicted on **Figure 3.4-1.** Data on private wells are supplied to NH GRANIT by the NHDES and were supplemented by field observations.[15] Community wells are operated either by a municipal entity or a group of private citizens who share the cost of installing and operating the wells and treating and delivering the water. No community wells are known to occur within the study area.

Wellhead Protection Areas (WHPAs) are created to prevent contamination of groundwater used for drinking water and encompass the surface and subsurface areas that are likely to contribute to underlying groundwater resources. WHPA delineations are based on a standard 4,000-foot radius or a fixed radius based on volume and existing site information. One Phase I wellhead protection area (*i.e.*, a wellhead delineated on the basis of existing information rather than a site-specific

▼

[15] The NHDES private well database is not a complete record of all private wells. Therefore, although not observed during field work, additional private wells may occur within the study area.

hydrogeological investigation) associated with the Pease International Tradeport occurs in the southwestern portion of the study area in Newington.

Water users who use more than 20,000 gallons of water per day are registered with the NHDES Water Management Bureau. According to the GIS data layer information supplied by NHDES, "use of water" includes the withdrawal of water from the ground or surface water body, the delivery of water from another supplier to the user indicated, the release of water from the user indicated to another facility, and/or the return of water to the environment (surface or groundwater). Users of 20,000 gallons of water or more are shown on **Figure 3.4-1**, where "S" indicates withdrawal from a surface water body, "G" indicates withdrawal from a groundwater supply, and "T" indicates transferred water between two facilities.

3.5 Farmlands

3.5.1 Regulatory Overview

The Farmland Protection Policy Act (FPPA) of 1984 [Section 1539-1549, Public Law 97-98, 95 Statute 1341-1344 (7 U.S.C. 4201 et seq.)] provides guidelines to federal agencies involved in projects that may convert existing or potential farmland areas to non-agricultural uses. The FPPA directs federal agencies to *"…(a) identify and take into account the adverse effects of their programs on the preservation of farmland, (b) to consider alternative actions, as appropriate, that could lessen adverse effects, and (c) to ensure that their programs, to the extent practicable, are compatible with State and units of local government and private programs and policies to protect farmland…"* (7 CFR 658.1). FHWA's Technical Advisory T6640.8A (October 30, 1987) further directs that impacts on farmlands be assessed as part of the environmental assessment for all transportation projects.

■

3.5.2 Methodology

The Natural Resource Conservation Service (NRCS) Soil Survey of Strafford County (Vieira and Bond 1973) and Rockingham County (Kelsea and Gove 1994) were used to identify important farmland soils within the study area. The NRCS field offices in Dover and Brentwood provided current lists of Prime, Statewide, and Locally Important Farmland soils for the study area (Table 3.5-1). Based on these lists, the Complex Systems Research Center at the UNH provided an electronic file of digitized soil units within the study area.

The FPPA excludes farmland soils that are in an "urbanized area." In addition, "farmland" does not include land already in urban development or water storage. Farmland "already in" urban development or water storage includes all such land with a density of 30 structures per 40-acre area. To calculate the remaining farmland within

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PORTSMOUTH
NEWINGTON
DURHAM
ROCKINGHAM COUNTY
STRAFFORD COUNTY
LITTLE BAY
PEASE BLVD
GOSLING RD
FOX RUN RD
WOODBURY AVE
SHATTUCK WAY
PAUL BROOK
PATTERSON LN
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
FOX POINT RD
FLAGSTONE BROOK
NIMBLE HILL RD
TRICKY'S COVE
RIVER RD
BLOODY POINT
UNNAMED PONDS
GUILFORD RR NEWINGTON BRANCH
PISCATAQUA RIVER
NEWINGTON
DOVER
DOVER POINT
BOSTON HARBOR RD
POMEROY COVE
ROYALS COVE
SPUR RD
BELLAMY RIVER
TOLL PLAZA
HOMESTEAD LN
DOVER POINT RD
PISCATAQUA RIVER
UNNAMED PERENNIAL STREAM
NEW HAMPSHIRE
MAINE

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- WELLHEAD PROTECTION AREA (NHDES PHASE 1)
- PRIVATE WELLS WITH 75' WELL PROTECTION ZONE

USERS OF 20,000+ (GAL./DAY)

- (S) SURFACE WATER
- (G) GROUND WATER
- (T) TRANSFERRED WATER BETWEEN TWO FACILITIES

TRANSMISSIVITY VALUES (SQ. FT/DAY)

- 4000 - 8000
- 2000 - 4000
- 1000 - 2000
- 1 - 1000

0 750 1500 Feet

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Figure 3.4-1
Water Resources

Date Created: 3/3/2004 j:\51425\cad\ev\planset\scoping\fig030401.dgn

the study area, US Census Bureau digital mapping of the Dover-Rochester Urbanized Area (UA) was overlaid onto the farmland soils mapping. Similarly, those areas with a density of 30 structures per 40-acre area were also overlaid onto the farmland soils mapping. Farmland soils within the boundary of the UA and within those areas meeting the density requirement were deleted from the subsequent analysis. The resulting data was then merged with the project base map to create the Important Farmland Soils map (**Figure 3.5-1**). A review of aerial photographs and field verification was also conducted to determine the presence of active farmlands within the study area.

■

3.5.3 Summary of Findings

The four categories of farmland in the Farmland Protection Policy Act (FPPA) of 1984 include Prime Farmland, Unique Farmland, Farmland of Statewide Importance, and Farmland of Local Importance. Collectively, these areas comprise approximately 430.9 acres within the study area. In addition, Active Farmland or Agriculture Areas are discussed. Each farmland category is described below:

- **Prime Farmland** is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed corps. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when the land is treated and managed using acceptable farming methods. Prime Farmland produces the highest yields with minimal inputs of energy and economic resources and causes the least damage to the environment. Prime Farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. Prime Farmland also has a favorable temperature and growing season and acceptable acidity or alkalinity. Prime Farmland has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and either does not flood frequently or is protected from flooding. The slope ranges mainly from 0 to 8 percent. Prime Farmland may now be in crops, pasture, or woodland, but not urban built-up land or water areas. It must either be used for producing food or fiber or be available for these uses. Prime Farmland soils occur in Newington, with larger concentrations found between Pickering Brook and Nimble Hill Road and near Tricky's Cove west of the Spaulding Turnpike; and within the central portion east of the turnpike, and in the vicinity of River Road extending to Bloody Point. Approximately 296.5 acres of NRCS mapped Prime Farmland soils occur within the study area.

- **Unique Farmland** is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops in New Hampshire are apple orchards, lowbush

blueberries, vegetable gardens, and maple sugar groves. Soils categorized as Unique Farmland by the NRCS do not occur within the study area.

Table 3.5-1
Important Farmland Soils of Strafford and Rockingham Counties in Study Area

Map Symbol	Map Unit	Acres
	Prime Farmland	
32A	Boxford Silt Loam, 0-3 Percent Slopes	254.0
460B	Pennichuck Channery Very Fine Sandy Loam, 3-8 Percent Slopes	42.5
	Statewide Importance	
32B	Boxford Silt Loam, 3-8 Percent Slopes	91.0
	Local Importance	
33A	Scitico Silt Loam, 3-8 Percent Slopes	34.8
460C	Pennichuck Channery Very Fine Sandy Loam, 8-15 Percent Slopes	0.6
538A	Squamscott Fine Sandy Loam, 0-5 Percent Slopes	8.0
	Total Important Farmland Soils	430.9

Data: Complex Systems Research Center, University of New Hampshire, 2003. Computations: Vanasse Hangen Brustlin, 2003.

- **Farmland of Statewide Importance** is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, these farmlands include those areas that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. The largest concentrations of Farmland of Statewide Importance soils within the study area occur in Newington, in the vicinity of Paul Brook and north of Patterson Lane to the east of the Spaulding Turnpike; and south of Pickering Brook and near the western boundary of the study adjacent to Little Bay to the west of the turnpike. Approximately 91 acres of NRCS mapped Farmland of Statewide Importance soils occur within the study area.

- **Farmland of Local Importance** includes certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops. In the study area, Farmland of Local Importance soils occur in Newington in the vicinity of the unnamed stream near the Portsmouth municipal boundary, to the east of the Spaulding Turnpike; and in the vicinity of Pickering Brook and near Fox Point Road near the western boundary of the study area. Approximately 43.4 acres of NRCS mapped Farmland of Local Importance soils occur within the study area.

- **Active Farmlands or Agriculture** is farmland that consists of lands, which may or may not have been previously categorized, but are currently in active agricultural

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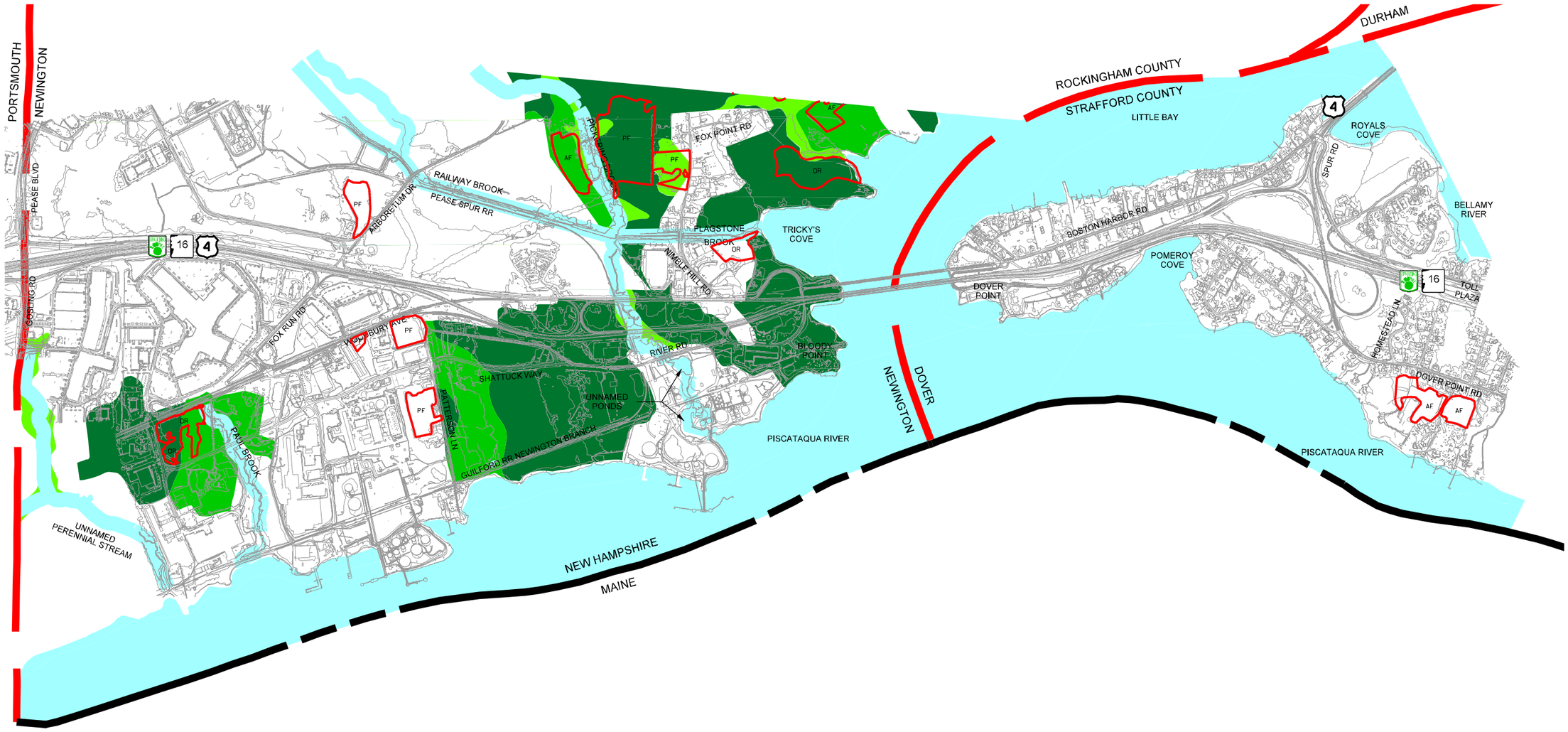

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- PRIME FARMLANDS
- FARMLANDS OF STATEWIDE IMPORTANCE
- FARMLANDS OF LOCAL IMPORTANCE

Active Farmlands

- PF — Pasture, Field
- OR — Orchard
- AF — Agriculture Field

0 750 1500 Feet

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Figure 3.5-1
Important Farmland Soils

Source: NRCS soil survey, Rockingham & Strafford counties. Farmland soils in an urbanized area (US census bureau) are not shown, as per Farmland Protection Policy Act.

use. These lands were identified by field survey, and include only those lands directly in, or adjacent to, the study area. Included under active agricultural uses are apple orchards, truck gardens, open fields, and pasturelands. Approximately 200 acres of Active Farmlands or Agriculture occur within the study area. Active farmland production within the study area includes hay fields and blueberry stands. In Newington, one area that is currently used for hay production includes a 20-acre field and a 10-acre field south of Patterson Lane. Another area in Newington includes about 140 acres of pasture and hayfield located to the south of Nimble Hill Road and north of Fox Point Road, though the hayfield north of Fox Point Road extends outside of the project study area. Active farmland in Dover consists of a 30-acre field east of Dover Point in Dover, used primarily for haying. In addition, an acre area of blueberry production occurs adjacent to these hayfields.

Areas mapped by the NRCS as Prime Farmland, Farmlands of Statewide Importance, and Farmlands of Local Importance soils occur adjacent to industrial, retail, and residential development, and forested upland and wetland habitats. Some areas designated by NRCS as farmland based on soil type include waterways and vegetated wetlands, and do not necessarily reflect those areas conducive to agricultural production. Other areas designated as active farmland are located outside of NRSC-designated farmland.

3.6 Wetland Resources

■

3.6.1 Regulatory Overview

Federal protection of wetlands is regulated under Section 404 of the Clean Water Act and Section 10 of the Federal Rivers and Harbors Act. The ACOE is charged with the duty of overseeing and regulating activities in wetlands at the federal level. The USEPA also reviews projects that may impact wetlands and has "elevational" review authority over discharges they find unacceptable.

The State of New Hampshire regulates activities in wetlands under RSA 482-A which grants regulatory authority to the NHDES, NHWB. Under this statute, all proposals to dredge or fill wetlands must be permitted by the NHDES, NHWB.

Communities in New Hampshire possess, at minimum, recommendation authority to the NHWB as to whether a permit to dredge or fill wetlands should be issued. The bulk of this recommendation responsibility is placed on the local Conservation Commissions. Individuals concerned with the protection of wetlands for certain projects generally express their concerns through the local commissions. Communities also have the ability to enact their own ordinances to regulate activities in wetlands. Both Newington and Dover have provisions within their local ordinances which

establish protection of wetlands, however, neither community has opted to establish Prime Wetlands pursuant to RSA 482-A.

■

3.6.2 Methodology

Identification of Wetland Resources

In New Hampshire, wetlands are identified using the federal definition and are delineated using the ACOE's three parameter approach that considers plants, soils and hydrology in the interpretation of the wetland/upland boundary (1987 ACOE Manual).

Wetland resources within the study area were identified through a combination of aerial photo interpretation and field verification. The first phase of wetland identification involved aerial photographic interpretation. The study site was flown in the summer of 2002 to produce 1:200 scale full color aerial photographs. National Wetland Inventory (NWI) wetland layers obtained from New Hampshire's GRANIT Geographic Information System (GIS) were first plotted onto the aerial photographs. A thorough interpretation of the aerial photographs was then conducted to refine the limits of NWI mapping and to identify additional wetland resources previously unmapped that occur within the study area.

During the second phase of wetland identification, environmental scientists conducted extensive field investigations during the months of June, July, and August of 2003. Limits of all wetland resources identified during the Phase I photo interpretation effort were verified for accuracy and photo mapping was adjusted in the field as appropriate. The limits of any additional wetlands identified in the field were then added to the aerial photo mapping. The wetland classification type for each wetland identified was field-verified based on Cowardin *et al.* (1979). The resulting wetlands mapping is depicted in **Figure 3.6-1.**

■

3.6.3 Summary of Findings

Description of Wetland Resources

Wetland resources within the study area are generally habitats fragmented by roadways, railways, and constricted hydrologic flows. Historically, these wetlands have been impacted by extensive residential, commercial, and industrial development that characterizes much of the study area.

National Wetland Inventory (NWI) maps use the Cowardin Classification System (Cowardin *et al*. 1979) to classify wetlands by "systems" according to plants, soils, and frequency of flooding. In the study area, these systems include palustrine, riverine,

and estuarine. Each of the systems is further subdivided into subsystems, classes, and subclasses based on substrate material, flooding regime, and vegetation type.

For the purposes of this report, the wetlands, water bodies, and waterways in the study area have been categorized based on the information contained on NWI and USGS maps, and field verification of these mapped resources. The wetland categories that occur within the study area include palustrine forested wetlands, palustrine scrub-shrub wetlands, palustrine emergent wetlands, freshwater ponds, estuarine intertidal and subtidal, and riverine (streams) resources. These categories are described below and the individual study area wetlands are presented in **Figure 3.6-1**.

Palustrine System Wetlands

Palustrine system wetlands include all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. The system also includes wetlands lacking vegetation, but having all of the following four characteristics: (1) and area less than 20 acres; (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 6 feet at low water; and (4) salinity due to ocean-derived salts less than 0.5 parts per thousand. The palustrine system is bounded by upland or by any of the other systems.

Forested Wetlands

Freshwater wetlands with at least 30 percent tree areal coverage are classified as palustrine forested wetlands (PFO). Field verification confirmed forested wetlands within the study area consist of deciduous forested swamps, coniferous forested swamps, and mixed deciduous/coniferous forested swamps.

Deciduous forested swamps in the study area are generally seasonally saturated and occur in isolated depressions or along rivers and streams. Dominant vegetation in the deciduous forested swamps consists of a red maple (*Acer rubrum*) overstory; ironwood (*Carpinus caroliniana*) and glossy buckthorn (*Rhamnus frangula*) shrub layer; and cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Osmunda sensibilis*), poison ivy (*Toxicodendron radicans*), skunk cabbage (*Symplocarpus foetidus*), and sphagnum moss (*Sphagnum* sp.) providing herbaceous ground cover. Deciduous forested swamps within the study area occur in both Dover and Newington. The majority of forested swamps are found west of the Spaulding Turnpike as the area is generally less developed. Relatively expansive forested wetlands are located between Exit 1 and Exit 3 near and within the Pease International Tradeport and west of Tricky's Cove. Smaller remnant forested wetlands also occur east of the highway, amongst commercial development near Gosling Road, Woodbury Avenue, and River Road.

In Dover, palustrine forested wetlands occur within the Exit 6 interchange and to the east of Dover Point Road amongst residential areas. Another larger forested system occurs west of the Spaulding Turnpike near Bayview Park north of Spur Road. Portions of this system are dominated by coniferous species.

Coniferous forested swamps occur in seasonally flooded acidic mineral soils in isolated depressions or along water courses within the study area. Dominant vegetation in the coniferous forested swamps consists of eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) in the overstory; glossy buckthorn and highbush blueberry (*Vaccinium corymbosum*) in the shrub layer; and sphagnum moss, cinnamon fern, poison ivy, and goldthread (*Coptis groenlandica*) as herbaceous ground cover.

Mixed deciduous/coniferous forested swamps occur in seasonally flooded pit-and-mound topography, consisting of saturated loamy/sandy/gravelly soils in isolated depressions, disturbed areas, or along water courses within the study area. Dominant vegetation in the mixed deciduous/coniferous forested swamps consists of red maple, white pine, eastern hemlock, silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), and white ash (*Fraxinus americana*) tree canopy; glossy buckthorn, northern arrow-wood (*Viburnum recognitum*), highbush blueberry, and nannyberry (*Viburnum lentago*) in the shrub layer; and cinnamon fern, sensitive fern, skunk cabbage, goldthread, poison ivy, and sphagnum moss in the herbaceous layer.

A good example of a mixed deciduous/coniferous forested swamp within the study area occurs in Newington near Exit 1, north of Pease Boulevard. Smaller pockets occur within other larger deciduous swamps previously described. In Dover, a large area of mixed deciduous coniferous forested swamp is located north of Exit 6 within Bayview Park.

Scrub-Shrub Wetlands

Freshwater wetlands with less than 30 percent tree aerial coverage and greater than 30 percent shrub aerial coverage are classified as palustrine scrub-shrub wetlands (PSS). Shrub wetlands also include wetlands where trees and shrubs cover less than 30 percent of an area alone, but in combination provide 30 percent or more aerial coverage.

Shrub wetlands within the study area generally occur as seasonally flooded, densely vegetated, fringing habitats bordering forested and emergent wetlands and along the edges of water bodies and waterways. Field verification confirmed that shrub wetlands consist of northern arrow-wood, highbush blueberry, glossy buckthorn, silky dogwood (*Cornus amomum*), speckled alder (*Alnus rugosa*), honeysuckle (*Lonicera* spp.), and multiflora rose (*Rosa multiflora*), with skunk cabbage, sensitive fern, cinnamon fern, and poison ivy in the herbaceous layer.

Most noteworthy are the extensive scrub-shrub thickets associated with the channelized Railway Brook, a tributary to Pickering Brook, extending from the Pease International Tradeport and eventually discharging as Flagstone Brook into Tricky's Cove in Newington. The scrub-shrub wetland east of River Road and south of Sprague Energy has been altered by vegetation clearing activities resulting in patchy areas of glossy buckthorn, red maple, gray birch (*Betula populifolia*), and speckled alder shrubs;

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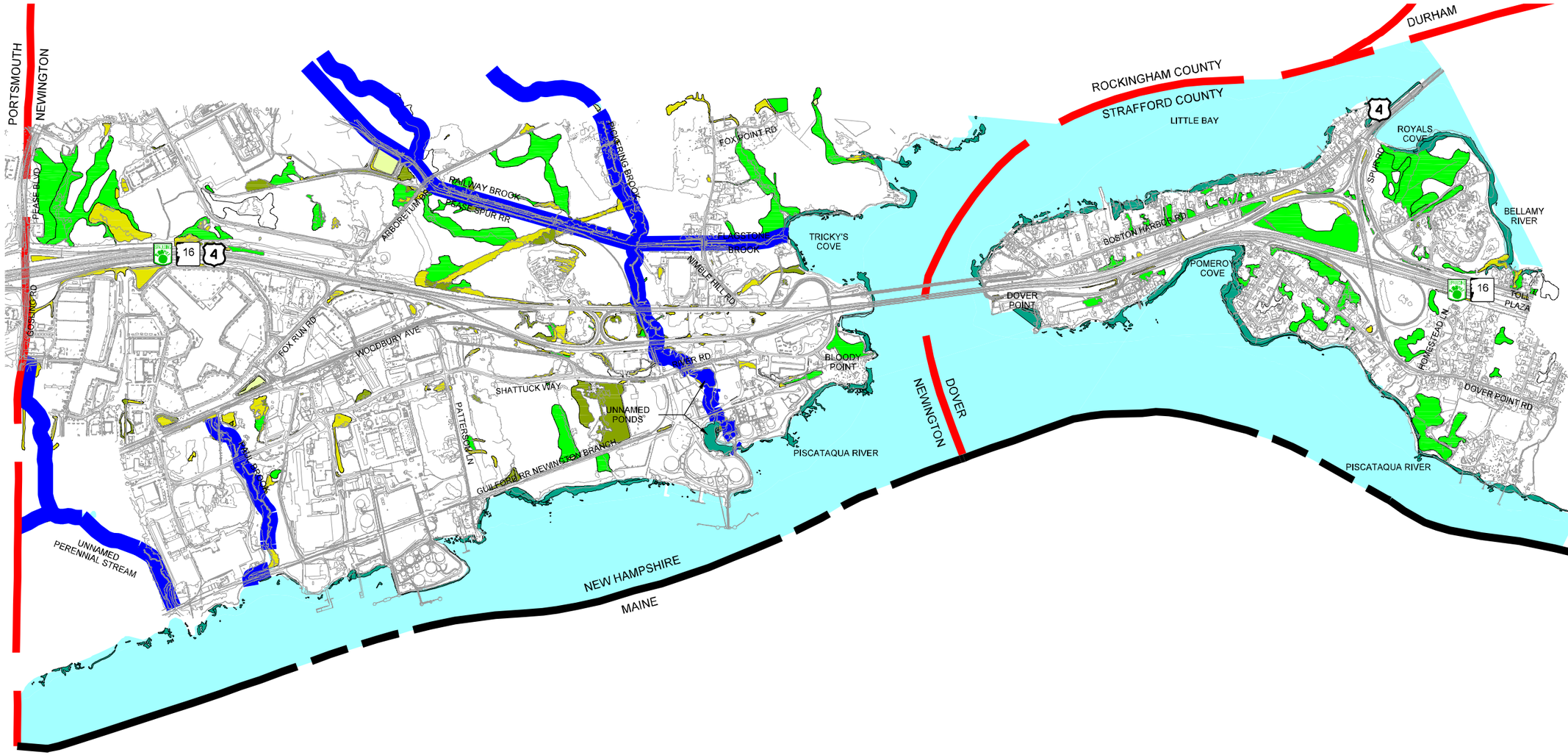

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE

DOMINANT WETLAND COVER TYPE

- PALUSTRINE, FORESTED
- PALUSTRINE, SCRUB-SHRUB
- PALUSTRINE, EMERGENT
- PALUSTRINE, UNCONSOLIDATED BOTTOM
- ESTUARINE, INTERTIDAL
- ESTUARINE, SUBTIDAL
- RIVERINE, LOWER OR UPPER PERENNIAL

0 750 1500 Feet

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Figure 3.6-1
Terrestrial Wetland Resources

rutted areas with purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), cattail (*Typha* spp.), and sedges (*Carex* spp.); and small upland inclusions vegetated with autumn olive (*Elaeagnus* spp.), bittersweet (*Celastrus* spp.), and gray birch. Other scrub-shrub swamps are located along utility easements located west of the highway between Exits 2 and 4. Additional smaller areas of scrub-shrub swamp collect highway drainage along the right-of-way or are marginal between forested wetlands and areas of emergent wetland. Other than along some of the highway drainage features, few substantial areas of scrub-shrub wetlands occur in Dover.

Emergent Wetlands

Wetlands in the study area identified as palustrine emergent wetlands (PEM) are freshwater wetlands (marshes and wet meadows) with a tree and shrub coverage less than 30 percent of the area, but where the total cover of emergent vegetation in the wetland is 30 percent or greater. Freshwater marshes are seasonally flooded wetlands commonly saturated at or near the surface when not flooded, and are dominated by grasses or grass-like plants. Freshwater wet meadows are seldom-flooded wetlands that are saturated throughout the growing season, and are dominated by herbaceous vegetation.

Freshwater emergent marshes in the study area are dominated by cattail (*Typha* sp.), wool grass *(Scirpus cyperinus)*, spike rush, lurid sedge *(Carex lurida)*, soft rush *(Juncus effusus)*, reed canary grass *(Phalaris arundinacea)*, sphagnum moss, and two exotic invasive species, common reed *(Phragmites australis)* and purple loosestrife *(Lythrum salicaria)*.

Examples of freshwater emergent marsh wetlands located in Newington include those found in numerous roadside drainage areas immediately adjacent to both sides of the Spaulding Turnpike. Larger areas of marsh wetland are also found associated with the circumneutral swamp (forested deciduous swamp) located west of Exit 1, north of Pease Boulevard. In Dover, freshwater emergent marshes are less numerous and located in similar landscape positions adjacent to the highway.

Emergent wet meadow wetlands are dominated by sensitive fern, fringed sedge *(Carex crinita)*, soft rush, wool grass, blue vervain (*Verbena* sp.), fox sedge *(Carex vulpinoidea)*, rough-stemmed goldenrod *(Solidago rugosa)*, redtop grass *(Agrostis solonifera)*, reed canary grass, purple loosestrife, and sphagnum moss.

Perhaps the best examples of wet meadow wetlands within the Newington portion of the study area can be found associated with areas of shrub wetland along the utility easements, and on the former drive-in theatre property west of the highway between Exit 2 and Exit 4. Other locations of wet meadow wetlands include areas near Paul Brook located to the east of Woodbury Avenue. In Dover, wet meadows can be found in the vicinity of the Exit 6 interchange.

Freshwater Pond

A single wetland is identified as a freshwater pond in the study area to the east of River Road, near the Sprague property. Classified as palustrine unconsolidated bottom (PUB), the small pond is in ecological succession to a freshwater marsh. Marsh plants such as cattail and common reed are growing thickly around its perimeter and toward the middle of the shallow pond. This pond flows east into a lower, tidally-influenced brackish pond, described below.

Estuarine System Wetlands

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of sea water. The estuarine system extends (1) upstream and landward to where ocean-derived salts measure less than 0.5 parts per thousand during the period of average annual low flow; (2) to an imaginary line closing the mouth of the river, bay, or sound; and (3) to the seaward limit of wetland emergents, shrubs, or trees where they are not included. Information on estuarine wetlands in the study area is presented below and in Section 3.2.8.

Intertidal Wetlands

Estuarine intertidal emergent (E2EM) wetlands are tidally-influenced vegetated wetlands commonly associated with a freshwater river or stream channel which is exposed and flooded twice daily by ocean tides. These areas also include associated splash zones.

Intertidal emergent wetlands within the study area consist of fringing salt marsh habitats, some with hydrologic constrictions resulting from roadway and railway fragmentation and under-sized culverts. Estuarine wetlands are typically dominated by salt marsh hay (*Spartina patens*), smooth cord grass (*Spartina alterniflora*), sea blite (*Sueda maritima*), glasswort (*Salicornia europea*), orach (*Atriplex patula*), and switch grass (*Panicum virgatum*).

Examples of estuarine tidally-influenced wetlands in Newington include those found along portions of the Piscataqua River, especially near the former outlet of Pickering Brook where tidal gates are located on industrial property. (Much of Pickering Brook's flow appears to now be diverted northward to Tricky's Cove via Flagstone Brook, a constructed, rip-rapped channel.) The lower reaches of Paul Brook also contain tidally-influenced marshes. In Dover, intertidal emergent wetlands include the area around Pomeroy Cove (discussed in Section 3.2.8), Hilton Park, and near the Scammel Bridge near the northwestern perimeter of the project study area.

Subtidal Wetlands

Estuarine subtidal unconsolidated bottom (E1UBL) wetlands are found in subtidal areas which are continuously submerged. These areas have at least 25 percent cover of particles smaller than stones, and a vegetative cover less than 30 percent. GRANIT NWI mapping indicates that all of the submerged areas of the Piscataqua River and Little Bay that extend beyond the areas mapped as estuarine intertidal wetlands are mapped as E1UBL. In addition, the eastern-most pond associated with Pickering Brook is also mapped as E1UBL.

A more detailed study conducted on a portion of the project area in the summer of 2003 indicates that subtidal areas are more diverse than NWI mapping indicates. According to the more recent mapping, the subtidal areas consist mainly of rocky bottom types ranging from small gravel to large boulders interspersed with widely scattered patches of soft sediments. Subtidal habitats near the bridges are all predominantly hard bottom, ranging from gravel to boulders. This area is a tidal rapid which regularly experiences tidal currents up to approximately 10 feet/second on spring tides. Hence, plants and animals living in these areas must be adapted for high-flow conditions, or live in micro-environments (*e.g.,* patches of soft sediment in a few areas) protected from the currents. See Section 3.2.8 for additional information.

Riverine System Wetlands

Riverine system wetlands include all wetlands and deepwater habitats contained within a channel, except for those wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and habitats with water containing ocean-derived salts in excess of 5 parts per thousand. Water is usually, but not always flowing in a riverine system. The riverine system is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs persistent emergents, emergent mosses, or lichens. In braided streams, the system is bounded by the banks forming the outer limits of the depression within which the braiding occurs. The riverine system terminates at the downstream end where the concentration of ocean-derived salts exceeds 0.5 parts per thousand during the period of annual average low-flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the riverine system. The Cowardin classification system further divides riverine systems into four sub-systems: tidal, lower perennial; upper perennial; and intermittent. The five streams that occur within the study area are classified as riverine, upper perennial or lower perennial waterways. All major rivers and streams in the study area have associated riverine wetlands (Section 3.2.3 and **Figure 3.6-1**). Table 3.6-1 presents the five study area streams and the dominant classification type of each stream.

Table 3.6-1
Study Area Waterway Classifications

Waterway	Cowardin Classification
Paul Brook	R3UB2H
Pickering Brook	R3UB3H
Flagstone Brook	R3UB1G
Railway Brook	R3UB1G
Unnamed Perennial Stream	R2UB2G

Note: R3UB = Riverine, Upper Perennial, Unconsolidated Bottom
R2UB = Riverine, Lower Perennial, Unconsolidated Bottom
2H = Sandy bottom, Permanently flooded
3H = Mud bottom, Permanently flooded
1G = Cobble-Gravel bottom, Intermittently exposed
2G = Sand bottom, Intermittently exposed

Upper Perennial

Riverine, upper perennial waterways consist of non-tidal high gradient channels with fast moving high velocity water flow. The gradient is high compared with that of the lower perennial subsystem, and there is very little floodplain development. Some water flows throughout the year in upper perennial streams. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration of unimpaired waters is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. In the study area, the dominant classification of Paul Brook, Pickering Brook, Flagstone Brook and Railway Brook is upper perennial.

Lower Perennial

Riverine, lower perennial waterways consist of non-tidal low gradient channels with slow moving slow velocity water flow. The gradient is lower than that of the upper perennial subsystem, and floodplain is well-developed. Some water flows throughout the year in lower perennial streams. The substrate consists largely of sand and mud. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The unnamed perennial stream located near the southern study area boundary is classified as lower perennial.

Vernal Pools

A formal vernal pool assessment has not yet been conducted in the study area for this project, hence no vernal pools are indicated on accompanying figures. Wetland assessments were conducted during late summer 2003, which is outside the "assessment window" for this habitat type. However, at the time of the wetland assessments, a few areas were identified that would likely provide the necessary habitat for breeding amphibians and reptiles. A formal assessment of the study area will be conducted during the optimal breeding season of April and May of 2004 to ascertain the presence (if any) of vernal pool habitat locations and species.

■

3.6.4 Wetland Functions and Values

Wetlands function not only as habitat for numerous aquatic plant and animal species, but are critical for the protection of many water resources. Wetlands help to filter and purify water by trapping soil particles along with the pollutants they carry before these pollutants enter watercourses. Wetlands have an ability to absorb nutrients such as nitrogen and phosphorus, and later release these nutrients when they are less likely to degrade water quality. Wetlands act to regulate the release of stormwater by acting as temporary storage basins, which can lower flood crests and reduce the destructive potential of severe storms. Wetlands stabilize the shores along rivers and lakes, as well, and further buffer the destructive forces of storms by absorbing the impact of waves. These actions alone can protect vast areas of shoreline property. Some wetlands also augment groundwater supplies by passing surface water and direct precipitation through the wetland soil into the underlying aquifers. The realization that wetlands provide certain functions and values from which the general public may benefit has led to the passage of Federal, State and local wetland laws and ordinances.

Study area wetlands provide a variety of habitats with unique functions and values. Coastal wetlands provide sediment and shoreline stabilization, flood flow alteration, and fish and shellfish habitat; scrub-shrub wetlands along watercourses provide nutrient uptake, production export, and sediment and shoreline stabilization; forested and scrub shrub floodplain wetlands provide nutrient, toxicant, and sediment retention, production export, and flood flow alteration; and emergent wetlands provide flood flow alteration, nutrient and sediment retention, and groundwater discharge/recharge functions. In addition, all wetland habitats within the study area provide wildlife habitat functions and values.

3.7 Vegetation and Wildlife Resources

The NHF&GD is responsible for managing and protecting resident wildlife species. NHF&GD has promulgated rules (FIS Chapter 1000) for the protection and management of these species. These rules pertain almost entirely to the exploitation of the species and not to the habitats. The rules set seasons, bag limits, and legal means for the taking of game, fish, and furbearing species.

The US Fish and Wildlife Service (USFWS) are responsible for managing and protecting migratory wildlife species. Except for threatened and endangered species and their associated "critical habitats," federal protection of wildlife on private property is confined to regulations regarding the exploitation of species and is not extended to wildlife habitat. Both wildlife species and wildlife habitats are generally protected on federal lands, including National Wildlife Refuges, National Parks and Monuments, and National Forests.

■

3.7.1 Wildlife Resources and Habitat Use

The occurrence of wildlife species and habitat use in the study area are heavily influenced by the geographic location of the habitats and surrounding land uses. The study area is located in coastal New Hampshire with the large Great Bay estuary to the west and the Piscataqua River to the east. Extensive commercial and industrial land uses in the Newington part of the study area, and residential development, as well as the Turnpike itself, in the Dover Point part, have fragmented and isolated most of the natural habitats in the study area.

Relative to bird species, the position of the study area between the Great Bay Estuary and the Piscataqua River increases the seasonal variability in both species diversity and numbers. During the spring and fall migration periods, habitats in the area serve as resting or stopover areas for neotropical migrants as they move north or south. During the breeding season (spring and early summer), bird species' diversity and numbers are more directly related to the specific types of habitat present as well as their size and carrying capacity (*i.e.*, quality). Species diversity during the winter, although influenced by anthropomorphic factors like bird feeders, is uniquely affected by the climatic characteristics of the coastal location of the study area. Temperatures tend to be more moderate along the coast in the winter, and the presence of open-water adjacent to the shore attracts a wide variety of overwintering waterfowl species and top predators, like the bald eagle (*Haliaeetus leucocephalus*).

Relative to mammalian species, the high density of commercial development in Newington and the peninsular nature of Dover Point limit movement of large, highly mobile mammalian species through the study area. In contrast, the presence of small and medium sized mammalian species having smaller home ranges is predictable from the types and sizes of habitats present. Since much of the study area is highly developed or residential, many small and medium-sized mammalian species characteristic of these developed habitats are present.

The relative scarcity of freshwater habitats largely influences the relative abundance of amphibian species. Pickering Brook is a perennial stream draining a freshwater marsh and a brackish pond as it flows southeastward into the Piscataqua River in Newington. Vernal pools are likely scarce and limited to undisturbed wooded habitat patches, although a formal survey has yet to be conducted. Except for their upland edge, the brackish tidal marshes (salt marshes) have no resident amphibian species and only an occasional reptile, such as the northern water snake or snapping turtle.

Typical habitats found in the study area are described below and shown on **Figure 3.7-1**. Representative species of each type are also given. Lists of species which could potentially utilize these habitats, were compiled from the NEWILD Computer Program (Thomasma, *et al.* 1998). NEWILD is software developed by the USDA that can be used to determine which of the 338 vertebrate species in New England may be

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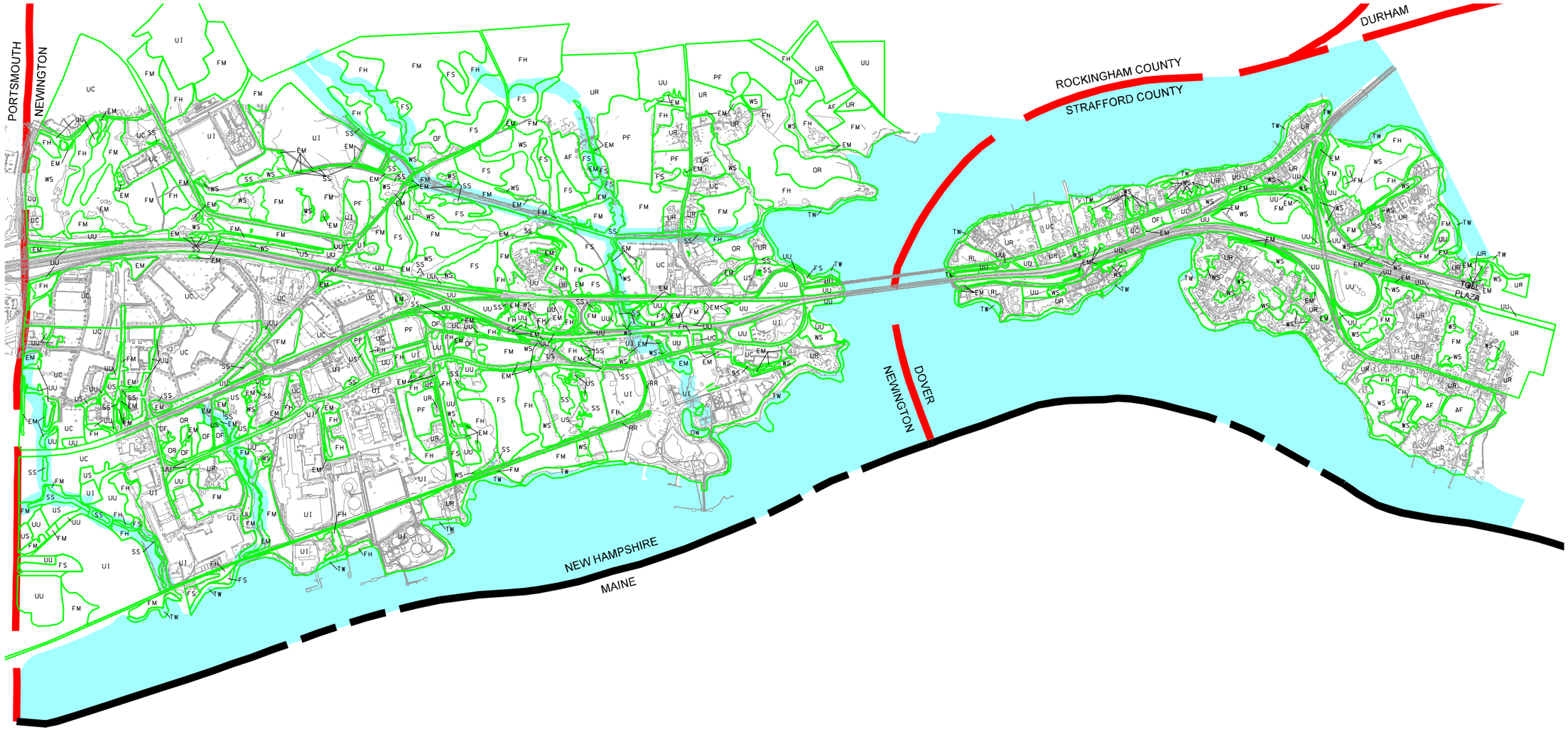

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE

TW	Tidal Wetland
UI	Urban Industrial
UC	Urban Commercial
OW	Open Water
UU	Urban Undeveloped
US	Upland Shrub
FM	Forested Mixed
FH	Forested Hardwood
FS	Forested Softwood
RR	Railroad
UR	Urban Residential
PF	Pasture, Field
OR	Orchard
AF	Agriculture Field
OF	Old Field
RL	Recreational Land
WS	Wooded Swamp
SS	Scrub-Shrub Swamp
EM	Emergent Marsh

0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.7-1
Habitat Cover Types

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found in a particular type of habitat. A listing for the habitats in the study area is available as a separate report for this project at the NHDOT.

Upland Types

Natural upland habitats in the study area include three forested communities (hardwood dominated, softwood dominated, and mixed); shrublands; grasslands including pastures and hayfields; and orchards. Although residential yards and other suburban/urban areas provide some habitat value for wildlife, their value is typically low compared to natural, undisturbed areas.

Hardwood Forest

The mature hardwood forests in the study area are typically dominated by red oak (*Quercus rubra*) and northern hardwoods such as American beech (*Fagus grandifolia*), yellow birch, and sugar maple often with a large component of softwoods such as white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*). There are usually four layers of vegetation, but only the overstory is dense. Common shrub species include witch hazel (*Hamamelis virginiana*), beaked hazelnut (*Corylus cornuta*), northern wild raisin (*Viburnum cassinoides*), and seedlings of red maple (*Acer rubrum*), American beech, white pine, eastern hemlock, and red oak. The herbaceous layer is typically sparse consisting of Canada mayflower (*Maianthemum canadense*) and several species of ferns. A litter layer comprised of leaves and dead twigs covers the ground.

Young hardwood stands, as typically found in recently cutover areas, are dominated by pioneer species like gray birch (*Betula populifolia)*, quaking aspen (*Populus deltoids*) and pin cherry (*Prunus pensylvanica*), as well as sprouts of red oak. With the reduced canopy layer (*i.e.*, shade) in these young stands, the herbaceous and shrub layer is usually dense.

In general, the greater the number of vegetation layers and the density of each (called structural diversity), the greater is the diversity of bird species. The mature hardwood stands have a moderate level of structural diversity while the young stands are slightly higher in diversity. The mature stands are characterized by bird species preferring a closed canopy *e.g.,* sharp-shinned hawk (*Accipter striatus*), barred owl (*Strix varia*), red-eyed vireo (*Vireo olivaceus*), black and white warbler (*Mniotita varia*), scarlet tanager, (*Piranga olivacea*), moderate size tree boles such as downy woodpecker (*Dendrocopus pubescens*), brown creeper (*Certhia familiaris*), and white-breasted nuthatch (*Sitta carolinensis*), or a forest floor with a thick litter layer including logs and scattered patches of herbaceous cover redback salamander (*Plethodon cinereus*) wood thrush (*Hylocichla mustelina*) and ovenbird (*Seiurus aurocapillus*). Mammals include gray fox, (*Urocyon ciereoargenteus*), gray squirrel (*Sciurus carolinensis*) southern flying squirrel, (*Glaucomys volans*), eastern chipmunk (*Tamias striatus*) and white-footed mouse, (*Peromyscus leucopus*). In comparison, the young stands are characterized by species more commonly associated with early successional stages like shrublands such as ruffed grouse (*Bonasa umbellus*), American redstart (*Septophaga ruticilla*), chestnut-sided warbler (*Dendroica pensylvanica*), willow flycatcher (*Empidonax traillii*), eastern cottontail

(*Sylvilagus floridanus*), white-footed mouse, and short-tailed shrew (*Blarina brevicauda*). White-tailed deer (*Odocoileus virginianus*) browse in both mature and young hardwood stands, primarily in those stands west of the Turnpike in Newington. Wild turkeys (*Meleagris gallopavo*) also utilize these hardwood stands as they are commonly observed on the Great Bay National Wildlife Refuge property, located just west of the study area.

Softwood Forest

Areas of softwood forest are dominated by either white pine or hemlock. Structural diversity is typically low to moderate. The dense shading results in an undeveloped shrub and herbaceous layer. The litter layer is characterized by needles and dead branches, leading to a highly acidic environment that also inhibits herbaceous growth.

Although softwood stands typically serve as deer wintering areas (because of the protection they afford from winds and low temperatures), their proximity to human development and isolation preclude them from serving this function. In the study area, other species typically associated with softwood forests include red squirrel, (*Tamiasciurus hudsonicus*) porcupine (*Erethizon dorsatum*), black-capped chickadee (*Parus atricapillus*), veery (*Catharus fuscescens*), and blackburnian warbler (*Dendroica fusca*).

Mixed Forest

The most common forest stands in the study area are typically mixed forest and composed of species found in both hardwood and softwood types. Their small size, however, limits species diversity. Vegetative structural diversity varies from moderately low to moderately high. Structurally these mixed stands are similar to hardwood stands and contain many of the same wildlife species such as veery, rose-breasted grosbeak (*Pheucticus ludvicianus*), red-backed salamander, eastern chipmunk, and gray squirrel.

Shrubland

Shrubland in the study area includes primarily “old fields" reverting to young forest. Old fields are classified as shrubland when they contain a shrub layer of at least 30 percent coverage with the remainder dominated by dense grasses and forbs.

Bird species typically associated with shrublands include chestnut sided warbler, common yellowthroat (*Geothlypis trichas)*, rufous-sided towhee *(Pipilo erythrophthalmus)*, prairie warbler (*Dendroica discolor)*, American goldfinch (*Spinus tristis)*, field sparrow (*Spizella pusilla)*, and song sparrow (*Melospiza melodia*). Common mammal species include white-footed mouse, short-tailed shrew, red fox (*Vulpes fulva*), and eastern cottontail.

Grassland/Agricultural Field

This habitat type includes both pastures and mowed fields, as well as the mowed right-of-way edge of the highway. There are several agricultural fields in the western portion of the study area in Newington. Structural diversity is characteristically low in this

habitat with the mowing diminishing both the cover and wildlife food value. Nonetheless, the edge created between this and other habitats, particularly forested areas, is very valuable. Species typical of this habitat and its edge include red-tailed hawk (*Buteo jamaicensis*), eastern meadowlark (*Sturnella magna*), American robin (*Turdus migratorius*), American goldfinch, song sparrow, yellow warbler (*Dendroica petechia*), woodchuck (*Marmota monax*), meadow vole (*Microtus pennsylvanicus*), eastern cottontail, and red fox. White-tailed deer may also be observed feeding in the open fields during warm summer evenings.

Orchard

Orchards are a habitat type closely related to grasslands because of their evenly spaced trees and the mowed herbaceous layer. The one orchard in the study area is located west of the Turnpike in Newington. Species representative of this type are typically a mix of those found in grasslands and young forests such as American kestrel (*Falco sparverius*), rose-breasted grosbeak (*Pheuticus ludovicianus*), Baltimore oriole, (*Icterus galbula*), eastern kingbird (*Tyrannus tyrannus*), woodchuck, meadow vole, short-tailed shrew, and red fox.

Wetland Types

Wetlands are a particularly important habitat for wildlife (see Section 3.6). All amphibians require freshwater or wet areas for breeding so their occurrence is dependent on wetlands. Vernal pools provide essential breeding habitat for mole salamanders (Genus *Ambystoma*) as well as wood frogs (*Rana sylvatica*). Many reptile species also depend on wetlands.

Described below are the major wetland types found in the study area along with representative species of each.

Forested Wetlands (Forested Swamps)

Forested wetlands in the study area are typically dominated by red maples with varying amounts of hemlock, and white pine intermixed. The typical interspersion of water and trees creates high structural diversity that enhances this habitat's value for wildlife. Common species include a variety of amphibians including spring peeper, (*Pseudacris crucifer*), gray treefrog (*Hyla versicolor*), wood frog, bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), mole salamanders and reptiles such as eastern ribbon snake (*Thamnophis sauritus*), ringneck snake (*Diadophis punctatus*), painted turtle, (*Chrysemys picta*) and snapping turtle (*Chelydra serpentina*).

The avian community found in red maple swamps is typically composed of facultative species, those which are found in upland forests as well, *e.g.*, black-capped chickadee, gray catbird (*Dumetella carolinensis*), ovenbird (*Seiurus aurocapillus*), wood thrush (*Hylocichla mustelina*), American robin and blue jay (*Cyanocitta stelleri*); (Golet *et al.* 1993). Other bird species appear to be attracted to this habitat because of the presence of water, *e.g.*, wood duck (*Aix sponsa*), American black duck (*Anas rubripes*), and mallard (*Anas platyrhynchos*). Bird species perhaps most characteristic of forested

wetlands of the northeast include northern waterthrush (*Seiurus noveboracensis*), Canada warbler (*Wilsonia pusilla*), and veery (Golet *et al*. 1993). Among raptors, red-shouldered hawks are probably most characteristic of forested wetlands where they both nest and hunt.

Characteristic mammalian species include beaver (*Castor canadensis*), raccoon (*Procyon lotor*), mink (*Mustela vison*), woodland jumping mouse (*Napaeozapus insignis*), and white-footed mouse.

Scrub-Shrub Swamp

Scrub-shrub swamps in the study area are dominated by species like highbush blueberry, willow (*Salix* spp.), alder (*Alnus* spp.), dogwood (*Cornus* spp.), and northern arrow-wood. Structural diversity is low because of the lack of multiple vegetation layers. Nonetheless there is typically dense shrub growth, along with dense herbaceous growth in spots. Seasonally this habitat (like forested wetlands) is frequently flooded by an adjacent stream or runoff from surrounding uplands.

Amphibians and reptiles commonly found in shrub swamps include spring peepers and wood frogs, while the presence of open water enhances the attraction for snapping turtles and painted turtles. Bird species commonly found in this habitat include American woodcock (*Philohela minor*), song sparrow, alder flycatcher (*Empidonax aluorum*), and tree swallow (*Iridoprocne bicolor*). Mammalian species include white-footed mouse, meadow jumping mouse (*Zapus hudsonius*), and raccoon.

Emergent Marsh

There are generally two types of emergent marshes in the study area: shallow marshes with water depths up to 1.5 feet characterized by persistent vegetation such as cattails (*Typha spp.*), various sedges, and two common invasive species, purple loosestrife and common reed. Frequently "wet meadows" or "sedge meadows" are included in the shallow marsh category. These meadows will have up to 6 inches of water in winter or early spring, but with an exposed, saturated soil surface in summer (Thomasma *et al*. 1998).

Typical species found in marshes include mallard, sora rail (*Porzana carolina*), American bittern (*Botarus lentiginosus*), great blue heron (*Ardea herodias*), red-winged blackbird (*Agelaius phoeniceus*), muskrat (*Ondatra zibethica*), foraging white-tailed deer, and common snapping turtle. During the dry summer months, meadow vole, meadow jumping mouse and American kestrel will be observed in shallow freshwater marshes and sedge meadows.

Open Water (Ponds)

There are only two "ponds" in the study area, both on the Newington side. Both are associated with Pickering Brook. The smallest one is freshwater and is now essentially an emergent marsh. The larger one is tidally-influenced with a tide-gate at its mouth with the Piscataqua River.

Wildlife use of these waterbodies is largely a reflection of the surrounding or bordering habitats and whether they are brackish. Shallow marsh or aquatic beds line the margins of these "ponds."

Wildlife representative of freshwater ponds include bull frog (*Rana catesbeiana*), pickerel frog (*Rana palustris*), painted turtle, hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), mallard, Canada goose (*Branta canadensis*), beaver, otter (*Lutra canadensis*), and mink.

Salt Marsh

Although the tidal marshes in the study area are very valuable habitat for birds and mammals, their brackish nature limits species diversity for amphibians and reptiles. There are no resident amphibian species and only an occasional water snake (*Nerodia sipedon*) or snapping turtle will be seen in them. In contrast, the salt marsh is ideal habitat for meadow voles, which adapt to the tidal cycle of inundation, and raccoons, which scavenge food at the water's edge. Norway rats (*Rattus norvegicus*), an urban species, are also a common resident in salt marshes because of their semi-aquatic nature and ability to adapt to fluctuations in water levels. The marsh is occupied by a wide variety of bird species with various sandpipers and plovers foraging the exposed shorelines at low tides such as greater yellowlegs (*Tringa melaleuca*), lesser yellowlegs (*T. flavipes*), killdeer (*Charadrius vociferous*); spotted sandpiper (*Actitis macularia*), least sandpiper (*Calidris minutilla)*, and semipalmated sandpiper (*Calidris pusilus*) and a variety of song birds occupying the marsh interior such as song sparrow, sharp-tailed sparrows (*Ammospiza caudacuta*), red-winged blackbird, and common yellowthroat. Barn swallows (*Hirundo rustica*) are also a common aerial feeder above the marshes, while herons and egrets such as black crowned night heron (*Nycticorax nycticorax*), and snowy egret (*Egretta thula*) forage within the marsh and along tidal creeks. A variety of waterfowl, including mallards, mute swans (*Cygnus olor*), and Canada geese, will also nest in this habitat or at its edge.

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3.7.2 Marine Mammals

The only marine mammal known to be resident in the study area is the harbor seal (*Phoca vitulina*) (NH Estuaries Project, 2000). Harbor seals are frequently observed in the open waters of Great and Little Bays, as well as the Piscataqua River. This species is more common downstream along the rocky coastline of Portsmouth. Harbor seals feed on a variety of fish and shellfish, some of commercial value. Another species, the Atlantic bottlenose dolphin (*Tursiops truncatus*), may occasionally enter the Piscataqua River estuary and may pass under the Spaulding Turnpike bridges to Great Bay. This latter species is more common south of Cape Cod (MA) and prefers pelagic (deep water) habitats, although it is also frequently found in harbors, bays, estuaries, and gulfs. Both species are protected under the Marine Mammal Protection Act of 1972 as administered by the National Marine Fisheries Service.

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3.7.3 Wildlife Refuges

The Great Bay National Estuarine Research Reserve is located approximately 3 miles west of the study area. This 5,280-acre reserve is managed by the NHF&GD, under the guidance of the National Oceanographic and Atmospheric Administration (NOAA).

The Great Bay National Wildlife Refuge lies just beyond the study area in the Hoyt Hill area of Newington, west of the Pease International Tradeport on Great Bay. The refuge contains a mix of both upland and wetland habitats and is a little over 1,000 acres in size (J. Reynolds, USFWS, pers. com.)

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3.7.4 Rare, Threatened, and Endangered Species

3.7.4.1 State Threatened and Endangered Species

State Regulatory Protection

In the State of New Hampshire, the Endangered Species Conservation Act (RSA 212-A) delegates authority and responsibility for the listing and protection of threatened and endangered species of wildlife to the NHF&GD. NHF&GD has in turn promulgated the rules for the protection of these species in Fish and Game Rules, Conservation of Endangered Species. These regulations restrict the transportation and killing or taking of listed species, but do not describe or protect the species' habitats. Species eligible for listing under these rules include invertebrate and vertebrate species of fish and wildlife (protection of plant species is described below). Protected animal species are placed in one of two categories, threatened or endangered, depending on their rarity.

NHF&GD manages threatened and endangered species cooperatively with the New Hampshire Natural Heritage Bureau (NHNHB). The NHNHB has compiled information on the distribution and abundance of these species from the literature, from files of area scientists, and from various field surveys, into computerized databases. These databases provide information on the present, past, or probable existence of such species for improved land use planning and environmental impact assessment.

The New Hampshire Native Plant Protection Act (RSA 217), enacted by the New Hampshire Legislature in 1987, established the authority for the State to develop a list of rare plant species. The NHNHB was empowered with this authority and developed the list in NH Administrative Rules Res. 1100, *et seq*. Plants deemed as rare in the State and in need of protection were listed as endangered, threatened, or special concern plant species in descending order of rarity.

Unlike federally-listed species (see Section 3.7.4.2), plant or wildlife species need only be rare within the State of New Hampshire to be state-listed, not rare over the entire range

of the species. Therefore, many state-listed species are rare because New Hampshire is at the edge of their range, or because there is a limited amount of habitat for the species within the state. Besides the prohibitions on the taking or killing of state-listed wildlife species, protection of state listed plants or animals is largely restricted to recommendations by the aforementioned state agencies for the approval or disapproval of projects which might impact the environment. All projects initiated or funded by the state, or applying for such state permits as Wetlands Permits or Site Specific Permits, are forwarded to NHF&GD and NHNHB, which have the opportunity to recommend approval or denial.

Study Area Occurrences

The NHNHB database contains specific or general (location) reports of six occurrences of state-listed (threatened or endangered) or species of special concern within or near the study area as listed in Table 3.7-1). In addition, the NHNHB identified two exemplary natural communities that occur within the study area: a Southern New England Acidic Seepage Swamp that occurs west of the Spaulding Turnpike and south of Nimble Hill Road in Newington; and a Southern New England Calcareous Seepage Swamp that occurs north of Pease Boulevard and west of the Spaulding Turnpike in Newington. Information on the documented occurrences of listed-species in the study area is provided in Tables 3.7-1, 3.7-2 and 3.7-3 and **Figure 3.7-2.**

Table 3.7-1
New Hampshire Natural Heritage Bureau Documented Occurrences of State-listed Species

Scientific Name	Common Name	Rank	Status	Location	Last Observed
Animal Species					
Ammodramus henslowii	Henslow's Sparrow	Extirpated	Special Concern	Newington, Fox Point Road	1983
Sterna hirundo	Common Tern	Not Ranked	Endangered	Newington, Hen Island	1995
Ammodramus savannarum	Grasshopper Sparrow	Not Ranked	Threatened	Newington, Pease Runway/Short Road	2002
Plant Species					
Cardamine bulbosa	Bulbous Bitter-Cress	Excellent Quality	Endangered	Newington, Paul Brook Swamp	1990
Polygonum prolificum	Prolific Knotweed	Historical/Current Condition Unknown	Threatened	Dover, Hilton State Park	1955
Eleocharis parvula	Small Spike-Rush	Fair Quality	Threatened	Dover, off Bay View Road	1996

Note: Data not field verified. The common tern and the grasshopper sparrow are found within the region, but are not recorded within the study area boundary.

Table 3.7-2
State and Federally Listed Threatened and Endangered Wildlife Species That May Occur within the Study Area*

Common Name	Scientific Name	Federal Status	State Status
Bald eagle	*Haliaeetus leucophalus*	Threatened	Endangered
Common tern	*Sterna hirundo*	Not Listed	Endangered
Grasshopper sparrow	*Ammodramus savannarum*	Not Listed	Threatened
Henslow's sparrow	*Ammodramus henslowii*	Not Listed	Special Concern

* Sources: Amaral, Michael, Endangered Species Specialist. US Fish and Wildlife Service, New England Field Office. Letter dated July 23, 2003; Cairns, Sara. New Hampshire Natural Heritage Bureau. Letter dated July 10, 2003.

Table 3.7-3
State and Federally Listed, Threatened, and Endangered Plant Species That May Occur within the Study Area*

Common Name	Scientific Name	Federal Status	State Status
Bulbous bitter-cress	*Cardamine bulbosa*	Not Listed	Endangered
Prolific knotweed	*Polygonum prolificum*	Not Listed	Threatened
Small spike-rush	*Eleocharis parvula*	Not Listed	Threatened

* Sources: Amaral, Michael, Endangered Species Specialist. US Fish and Wildlife Service, New England Field Office. Letter dated July 23, 2003; Cairns, Sara. New Hampshire Natural Heritage Bureau. Letter dated July 10, 2003.

The study area may include as many as four species of wildlife, all of which are avian species, which are officially tracked by the State (state-listed or species of concern) per the Endangered Species Conservation Act (RSA 212-A). Two of these species, the bald eagle and the common tern, are listed as endangered under state law. A third species, the grasshopper sparrow is listed as threatened, while the fourth species (Henslow's sparrow) is listed as a species of special concern.

In addition to the exemplary natural communities listed above, the study area includes three known plant populations listed as endangered or threatened per the New Hampshire Native Plant Protection Act (1987 RSA 217) and its Administrative Rules (Res 1100). Both the prolific knotweed and the small spike rush are state-threatened, while the bulbous bitter-cress is listed as endangered in the state of New Hampshire.

3.7.4.2 Federal Threatened and Endangered Species

Federal Regulatory Protection

The Endangered Species Act of 1973 (ESA), recognizes the need and provides the means to protect rare plants, and invertebrate and vertebrate species of fish and

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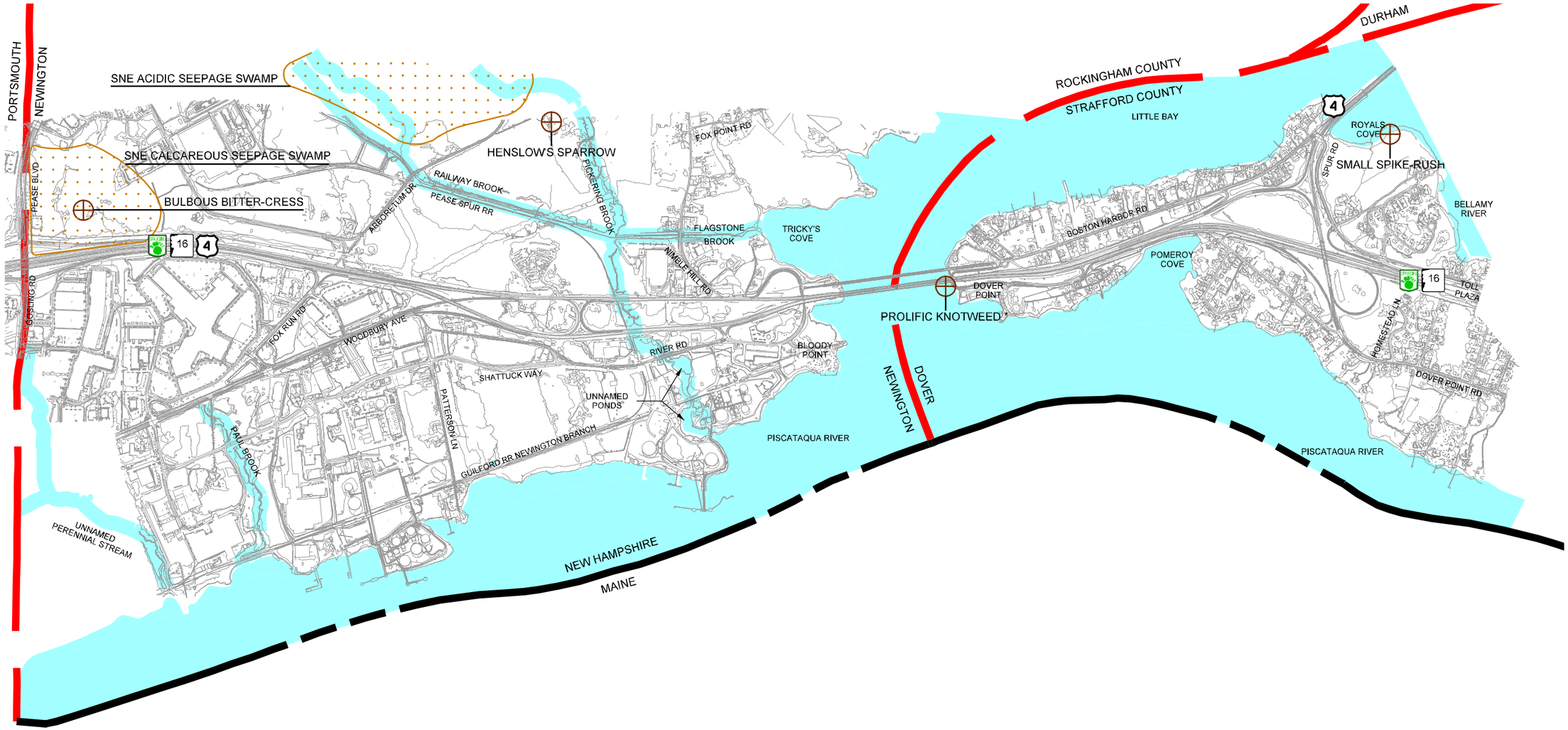

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- POPULATION OF PROTECTED SPECIES
- EXEMPLARY NATURAL COMMUNITY (NHNHB)

0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.7-2
Threatened and Endangered Species

* Prolific knotweed population known only from an historic record.

wildlife, and provides for the protection and/or acquisition of critical habitats and the management of endangered species. The 1973 Act replaced 1969 and 1966 laws which provided for listing of endangered species but provided little meaningful protection. The 1973 Act has been reauthorized eight times. Significant amendments have been enacted in 1978, 1982, and 1988, while the overall framework of the 1973 Act has remained essentially unchanged. Per the 1978 Amendments to the ESA, separate (geographically or genetically isolated) but rare populations of fish and wildlife (but not plants or invertebrates) may be protected as well as entire species. Listed species are categorized as either endangered species, which are in danger of extinction throughout all or a substantial portion of their ranges, or threatened species, which are likely to become endangered throughout all or a substantial portion of their ranges.

Section 7 of the ESA dictates that all federal agencies must consult the US Department of the Interior (USDOI) to ensure that actions taken under federal funding, federal assistance, or federal permits (*e.g.*, Section 404 Wetland Fill Permits) do not jeopardize the existence of threatened or endangered species. Jurisdiction is given to the USDOI to recommend changes to the project to avoid such jeopardy (including impacts to the habitat as well as to the plants or animals themselves).

Occurrence in Study Area

The USFWS has determined (letter dated July 23, 2003, Appendix D) that one federally-listed species, the bald eagle, uses the Great Bay estuary as wintering habitat. In addition to this species, the USFWS recommends that a suitable habitat evaluation be conducted within the study area for the New England cottontail (*Sylvilagus transitionalis*), a species currently under petition for endangered species evaluation.

3.8 Air Quality

Changes in the operation of the Spaulding Turnpike and associated roads have the potential to affect air quality. While the net change of relieving congestion is typically beneficial, an air quality analysis will be conducted and reported in the Draft EIS.

For traffic-related impacts, the pollutants of interest are carbon monoxide and ozone. The primary concerns will be:

- Whether the proposed roadway alternatives will create or exacerbate violations of carbon monoxide (CO) standards, and

- Whether the proposed action will increase or decrease the regional emissions of ozone precursors [primarily volatile organic compounds (VOCs) and nitrogen oxides (NOx)].

The purpose of the air quality study will be to determine whether the proposed improvements to the Spaulding Turnpike would violate the State Implementation Plan

(SIP) for air quality. The air quality study will include a microscale modeling analysis that will predict CO levels at critical receptor locations along the project corridor. The microscale analysis will be conducted according to USEPA's guidelines. The air quality study will also describe the contribution of the project to the regional emissions of the ozone precursors.

The study area is located in Strafford and Rockingham Counties, which is currently designated as a "Serious" non-attainment area for ozone and an attainment area for CO.

■

3.8.1 Years of Analysis

The mobile source analysis will evaluate the existing year (2003), the estimated year of completion (2013), and the design year (2025). The existing conditions will be updated to reflect the new "baseline" year in the Traffic Analysis section.

■

3.8.2 Regional Emissions

The proposed improvements to the Spaulding Turnpike must demonstrate that the regional emissions comply with the Transportation Conformity requirements. This project is included in the current Transportation Improvement Program and Transportation Plan. Therefore, a separate mesoscale analysis will not be conducted. The air quality analysis will document and summarize the proposed project's compliance with the Transportation Conformity requirements.

■

3.8.3 Microscale Analysis

3.8.3.1 Dispersion Model

The microscale analysis will be conducted utilizing the CAL3QHC Version 2 model for free flow and intersection roadway links. CAL3QHC is recommended by the USEPA and is required by USEPA Region I for the air quality analysis of major congested intersections. The effect and extent of vehicle queuing on CO levels at each intersection will be determined by CAL3QHC, by evaluating the following input: the MOBILE 6 idle emission factors, total signal cycle time, effective red time, assigned traffic volumes, and capacity of intersection. The data will be used to develop queue lengths at approaches of each analysis site.

3.8.3.2 Analysis Sites

The air quality study will need to review and evaluate build traffic volume data before identifying the intersections to be modeled. Existing conditions will be documented in

the DEIS. The analysis sites will be chosen according to USEPA criteria. Intersections will be ranked according to traffic volumes and LOS (See USEPA's "Guidelines for Modeling Carbon Monoxide From Roadway Intersections"). These sites will include locations that may potentially be affected by critical roadway links and intersections. These sites will be determined in coordination with the traffic analysis and land use information. It is anticipated that seven (7) air quality analysis sites will be selected. Up to six (6) of these sites will be at congested intersections within the study area. The seventh site will probably be along the right-of-way of the affected portions of the Spaulding Turnpike itself. The final selection of these sites will be made in consultation with the applicable air quality review agencies.

Receptor locations will be assigned to each analysis site. The number and location will be determined on an individual basis for each site. There will be approximately twenty (20) specific air quality receptor locations at each analysis site to ensure that the worst case location is identified. The microscale analysis will report the highest CO concentration for each quadrant of intersections that are evaluated. The receptor heights will be 1.5 meters (5 ft.) above grade.

3.8.3.3 Emission Rates

The vehicle emission factors that will be used in the microscale analysis will be obtained using the latest version of USEPA's MOBILE computer model, currently MOBILE 6. MOBILE 6 calculates CO emission factors for motor vehicles. The emission factors will be adjusted to reflect New Hampshire-specific conditions, such as temperatures representative of the pollutant season and appropriate fuel programs.

3.8.3.4 Worst-Case Meteorological Conditions

The worst case meteorological conditions, including wind speed, stability class, ambient temperature, and persistence factor will be selected and utilized for the microscale analysis peak one-hour period as follows:

- Wind Speed: 1m/s
- Wind Direction: Worst-case wind angle search
- Wind Angles: 10-degree increments from 0 to 360 degrees
- Stability class: D
- Temperature: 30 degrees Fahrenheit
- Mixing Height: 1,000 meters

■

3.8.4 CO Background Values

In determining the total impact of the project, it is necessary to include consideration of the background CO levels for the area. The background level is the component of the total concentrations not accounted for through the individual roadway links. Background CO concentrations of 2.0 ppm will be used. The NHDES shall be contacted to confirm the acceptability of these background values.

■

3.8.5 Model Predictions

The air quality study will evaluate the existing conditions, the estimated year of project opening, and the design year. The CO concentrations for the future years will include No-Build and Build alternatives. The maximum one-hour and eight-hour concentrations will be estimated at each analysis site. The CO results will be compared with both the National and State Ambient Air Quality Standards.

An assessment of the consistency of each alternative with the strategies contained in applicable parts of the State Implementation Plan (SIP) for the area will be prepared. This analysis will include a discussion of possible traffic control measures and physical improvement necessary to attain CO standards as specified in the SIP. An assessment of this project, with respect to the Transportation Conformity requirements of the 1990 Clean Air Act Amendments, will also be conducted.

3.9 Noise

Changes in traffic patterns or volume as well as physical changes in the roadway can affect the generation and propagation of noise. A noise analysis designed to indicate the magnitude and extent to which noise-sensitive receptors would experience changes in noise due to the proposed improvements to the Spaulding Turnpike between Exit 1 in Newington and the Toll Plaza in Dover will be conducted. The noise analysis will follow the NHDOT's "*Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects*" dated July 1996, and FHWA's regulations outlined in 23 CFR 772.

The noise analysis will evaluate the highest sound levels in the study area. A review of the traffic data indicates that the highest sound levels on the southbound side of the Spaulding Turnpike can be expected to occur during the weekday morning and on the northbound side during the weekday evening. Therefore, the noise analysis will evaluate the receptor locations along the southbound roadway using morning peak hour volumes and the receptor locations along the northbound roadway using evening peak hour volumes.

Noise monitoring was conducted at seven receptor locations in conformance with the FHWA noise monitoring guidelines. Traffic data was obtained at the same time as the sound level data. This traffic data included traffic volumes, vehicle mix (automobiles, medium trucks, and heavy trucks), and operating speeds. The traffic data and roadway geometry were used to predict sound levels at each noise monitoring site. The sound level results and the noise monitoring data were used to calibrate the noise prediction model.

Receptor locations sensitive to highway traffic noise include, but are not limited to, residences, churches, schools, libraries, meeting halls, parks, and natural areas. Commercial businesses may also be sensitive to noise, although to a lesser degree in most instances. The project contains a mix of sensitive land uses.

The FHWA recommended computer program model, Traffic Noise Model (TNM), will be used to predict noise levels at all receptor locations affected by any of the project alternatives, including the No-Build alternative.

The noise modeling input data will include peak hour traffic volumes, vehicle mix, vehicle speeds, and roadway and receptor geometry. The existing and future (design year) sound level predictions will be based on the highest noise period. The noise analysis will calculate the sound levels at each receptor location and compare the results to the NHDOT and FHWA noise impact criteria. Where noise impacts are identified, mitigation measures will be evaluated to determine if they are reasonable, feasible, and likely to be included in the project.

Traffic noise impacts occur when predicted noise levels approach (within 1 dBA), are at or exceed the FHWA Noise Abatement Criteria (67 dBA for residences; 72 dBA for businesses) or when build noise levels substantially exceed existing noise levels. In New Hampshire, substantially exceeding the existing noise levels means an increase of 15dBA or more. It is generally observed that a 0-5 dBA increase/ decrease represents a slight change; a 6-15 dBA increase/decrease represents a moderate change; and a greater than 15 dBA increase/decrease reflects substantial change. Where noise impacts are identified, NHDOT/FHWA noise abatement guidelines will be followed to evaluate the possibility of providing noise abatement as part of the project.

■

3.9.1 Existing Conditions

The noise analysis determined existing conditions by TNM modeling and a noise monitoring program. The noise monitoring program was conducted to obtain a sampling of the existing sound levels in the Spaulding Turnpike corridor and to provide a database for calibrating the noise model. The noise monitoring was conducted at seven receptor locations, typically residences, in October of 2003 (**Figure 3.9-1**). Little to no difference in sound levels between the monitoring locations and the model results confirm that the model is properly calibrated, and therefore predicting accurate sound levels.

Table 3.9-1
Existing Noise Evaluation

Area[1]	Location	A-Weighted Sound Level in Decibels (dBA) FHWA Criterion	Sound Levels L_{eq}
1	Fox Run Road – Newington	67	62-68[2]
2	Old Dover Road – Newington	67	55-64
3	Patterson Lane – Newington	67	45-52
4	Nimble Hill Road – Newington	67	54-65
5	River Road – Newington	67	57-70[2]
6	Bloody Point – Newington	67	58-62
7	Hilton Park	67	62-67[2]
8	Hilton Dr / Wentworth Terr – Dover	67	65-69[2]
9	Boston Harbor Road – Dover	67	61-75[2]
10	Boston Harbor Road north – Dover	67	59-62
11	Dover Point Road – Dover	67	57-71[2]
12	Spur Rd / Bayview Park – Dover	67	45-63
13	Spur Rd / Clearwater Dr – Dover	67	49-66[2]
14	Homestead Road – Dover	67	55-58

Source: VHB, Inc.
1 The noise evaluation areas are depicted in **Figure 3.9-1**.
2 The sound level approaches, is at, or exceeds the FHWA noise abatement criterion under existing conditions.

These noise measurements were collected in conformance with the FHWA noise monitoring guidelines. Traffic data were obtained at the same time as the sound level data. This traffic data included traffic volumes, vehicle mix (automobiles, medium trucks, and heavy trucks), and operating speeds. Noise sources in the study area included vehicles on the Spaulding Turnpike and vehicles on local roadways.

■

3.9.2 Receptor Locations

The study area was evaluated to identify receptor sites that have outdoor activities that might be sensitive to highway noise. In evaluating the Spaulding Turnpike corridor, the study area was subdivided into 14 areas containing receptor sites that are sensitive to highway noise. Within the subdivisions, approximately 28 receptor sites were identified along the Spaulding Turnpike corridor. The receptor locations, which predominantly included outdoor ground level residential areas, are shown in **Figure 3.9-1**. Most of the receptor locations (residences) fall into the FHWA's "Activity Category B," which has a noise abatement criterion of 67 dBA. Other land uses, such as commercial buildings, (*i.e.*, those that do not involve temporary overnight residence), are in FHWA "Activity Category C" which has a noise abatement criterion of 72 dBA.

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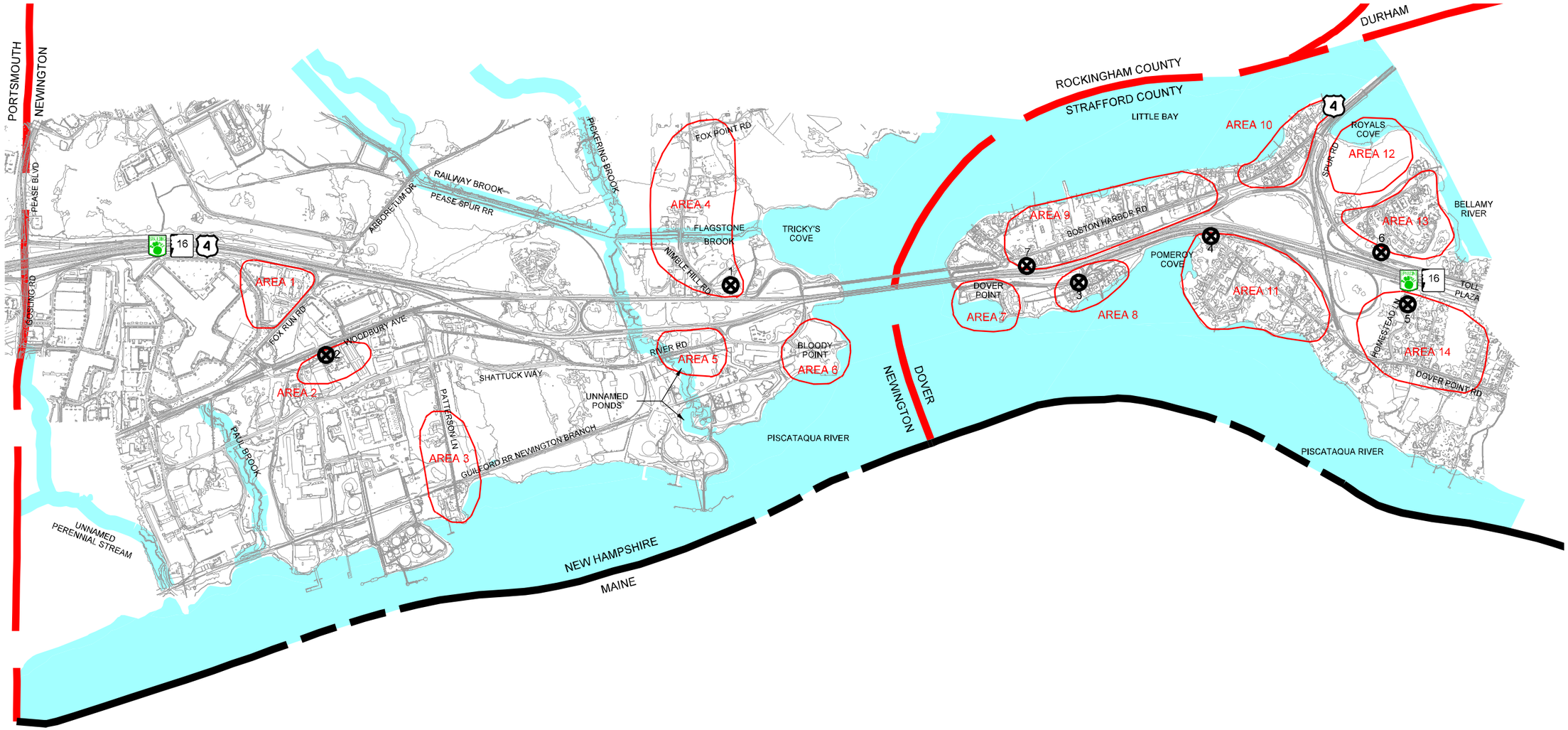

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- EXISTING NOISE MONITORING LOCATION
- NOISE EVALUATION AREA

0 750 1500 Feet

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Figure 3.9-1
Sensitive Receptor Locations

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■

3.9.3 Model Predictions

The noise analysis will evaluate the future design year No-Build and Build alternatives. Once the future alternatives have been developed, the TNM model inputs will be developed and future sound levels will be calculated. The sound level results will be compared with the NHDOT and FHWA noise criteria. An assessment of the results of each alternative will be conducted and noise mitigation measures will be evaluated to determine their feasibility.

3.10 Socio-Economic Conditions

■

3.10.1 Socio-Economic Study Area

The socio-economic study area for this project has both a regional and local component. The broader regional study area includes 30 municipalities within the tri-county area of Strafford, Rockingham and Carroll Counties, in the southeast portion of New Hampshire. The more localized project study area includes portions of the Town of Newington and the City of Dover that border the 3.5-mile section of the Spaulding Turnpike being evaluated for upgrading. Both study areas are illustrated in **Figure 1.2-4**.

■

3.10.2 Population and Employment

The socio-economic study area has experienced substantial growth over the last 20 to 30 years. However, the rate of growth over the most recent decade, between 1990 and 2000, was considerably slower than in the two previous decades (1970-1990). As indicated in Table 3.10-1, population growth in the Strafford County portion of the socio-economic study area consistently exceeded that of the Rockingham County portion for all three decades examined. Within the foreseeable future, however, it is unlikely that the growth rates experienced during the 1970s and 1980s will be repeated again for two reasons. The first is a diminishing land supply and escalating costs of housing construction. The second is that considerable changes have been made to land use regulations in socio-economic study area communities since the boom growth of the 1980s, as well as the fact that many communities are now taking a more pro-active approach to managing growth and preserving open space. In addition, recent population growth rates and the average household size have declined within almost all communities in the socio-economic study area over the last decade, as depicted in Table 3.10-2. The trend has potential implications for long-term planning. The first is that the projected decline in the rate of population growth for the socio-economic study area will not necessarily result in a corresponding decrease in the number of new

households and new housing units created within the socio-economic study area in the future. The second is that a decreasing household size may also affect the average number of vehicle trips typically associated with specific housing types such as single and multi-family dwellings. Whether or not the continuing decline in average household size will result in a reduction in the number of vehicle trips cannot be determined from the available data. However, it is a trend that warrants further examination since it is reasonable to assume that it may be a factor that affects overall use of the area's transportation system. Tables 3.10-3 and 3.10-4 indicate that housing costs rose steadily throughout the socio-economic study area with home sale prices increasing annually by approximately 8 percent between 1992 and 2002. The Strafford area consistently had lower average prices throughout the decade, in comparison to the Rockingham area, although its rate of appreciation (119.6 percent) during this time period exceeded Rockingham's (106.6 percent). This is an indication of the role that the Strafford housing market plays in offering more affordable housing in contrast to the higher priced homes available in the remainder of the socio-economic study area.

Total employment within the socio-economic study area as of 2001 was approximately 106,900. Employment increased by a rate of 26.8 percent between 1993 and 2001, slightly exceeding the State of New Hampshire's 24.7 percent rate of growth. During this time period, total private sector employment increased by approximately 21,000, or almost 30 percent, while government sector employment increased by approximately 1,500, or 11.3 percent. The redevelopment of the Pease International Tradeport has played a substantial role in the area's employment growth. Since the facility was converted to civilian use in the early 1990s, approximately 4,900 jobs have been created there, roughly equivalent to 20 percent of the total increase that occurred within the socio-economic study area over the decade.

Vacancy rates in the office and industrial building markets within the socio-economic study area are relatively high. As of 2002, vacancy rates were estimated to be 15 percent for office properties and 12 percent for industrial facilities. Retail properties however, appear to be in better condition with an estimated vacancy rate of only 7.6 percent. At the Pease International Tradeport alone, vacancies for office and industrial facilities were even higher with respective rates of 20 percent and 30.7 percent. These higher vacancies are largely attributable to the downsizing that has recently occurred in the high-tech industrial sector.

Table 3.10-1
Total Population 1970-2000
Socio-Economic Study Area

	Population				Change				% Change				Avg. Annual % Change	
	1970	1980	1990	2000	70-80	80-90	90-00	70-00	70-80	80-90	90-00	70-00	90-00	70-00
Barrington	1,865	4,404	6,164	7,475	2,539	1,760	1,311	5,610	136.1	40.0	21.3	300.8	1.9	4.7
Dover	20,850	22,377	25,042	26,884	1,527	2,665	1,842	6,034	7.3	11.9	7.4	28.9	0.7	0.9
Durham	8,869	10,652	11,818	12,664	1,783	1,166	846	3,795	20.1	10.9	7.2	42.8	0.7	1.2
Farmington	3,588	4,630	5,739	5,774	1,042	1,109	35	2,186	29.0	24.0	0.6	60.9	0.1	1.6
Lee	1,481	2,111	3,729	4,145	630	1,618	416	2,664	42.5	76.6	11.2	179.9	1.1	3.5
Madbury	704	987	1,404	1,509	283	417	105	805	40.2	42.2	7.5	114.3	0.7	2.6
Middleton	430	734	1,183	1,440	304	449	257	1,010	70.7	61.2	21.7	234.9	2.0	4.1
Milton	1,859	2,438	3,691	3,910	579	1,253	219	2,051	31.1	51.4	5.9	110.3	0.6	2.5
New Durham	583	1,183	1,974	2,220	600	791	246	1,637	102.9	66.9	12.5	280.8	1.2	4.6
Rochester	17,938	21,560	26,630	28,461	3,622	5,070	1,831	10,523	20.2	23.5	6.9	58.7	0.7	1.6
Rollinsford	2,273	2,319	2,645	2,648	46	326	3	375	2.0	14.1	0.1	16.5	0.0	0.5
Somersworth	9,026	10,350	11,249	11,477	1,324	899	228	2,451	14.7	8.7	2.0	27.2	0.2	0.8
Subtotal Strafford Area	**69,466**	**83,745**	**101,268**	**108,607**	**14,279**	**17,523**	**7,339**	**39,141**	**20.6**	**20.9**	**7.2**	**56.3**	**0.7**	**1.5**
Brentwood	1,468	2,004	2,590	3,197	536	586	607	1,729	36.5	29.2	23.4	117.8	2.1	2.6
East Kingston	838	1,135	1,352	1,784	297	217	432	946	35.4	19.1	32.0	112.9	2.8	2.6
Epping	2,356	3,460	5,162	5,476	1,104	1,702	314	3,120	46.9	49.2	6.1	132.4	0.6	2.9
Exeter	8,892	11,024	12,481	14,058	2,132	1,457	1,577	5,166	24.0	13.2	12.6	58.1	1.2	1.5
Greenland	1,784	2,129	2,768	3,208	345	639	440	1,424	19.3	30.0	15.9	79.8	1.5	2.0
Hampton	8,011	10,493	12,278	14,937	2,482	1,785	2,659	6,926	31.0	17.0	21.7	86.5	2.0	2.1
Hampton Falls	1,254	1,372	1,503	1,880	118	131	377	626	9.4	9.5	25.1	49.9	2.3	1.4

Table 3.10-1 (continued)

	Population				Change				% Change				Avg. Annual % Change	
	1970	1980	1990	2000	70-80	80-90	90-00	70-00	70-80	80-90	90-00	70-00	90-00	70-00
Kensington	1,044	1,322	1,631	1,893	278	309	262	849	26.6	23.4	16.1	81.3	1.5	2.0
New Castle	975	936	840	1,010	-39	-96	170	35	-4.0	-10.3	20.2	3.6	1.9	0.1
Newfields	843	817	888	1,551	-26	71	663	708	-3.1	8.7	74.7	84.0	5.7	2.1
Newington	798	716	990	775	-82	274	-215	-23	-10.3	38.3	-21.7	-2.9	-2.4	-0.1
Newmarket	3,361	4,290	7,157	8,027	929	2,867	870	4,666	27.6	66.8	12.2	138.8	1.2	2.9
North Hampton	3,259	3,425	3,637	4,259	166	212	622	1,000	5.1	6.2	17.1	30.7	1.6	0.9
Portsmouth	25,717	26,254	25,925	20,784	537	-329	-5,141	-4,933	2.1	-1.3	-19.8	-19.2	-2.2	-0.7
Rye	4,083	4,508	4,612	5,182	425	104	570	1,099	10.4	2.3	12.4	26.9	1.2	0.8
Stratham	1,512	2,507	4,955	6,355	995	2,448	1,400	4,843	65.8	97.6	28.3	320.3	2.5	4.9
Subtotal Rockingham Area	**66,195**	**76,392**	**88,769**	**94,376**	**10,197**	**12,377**	**5,607**	**28,181**	**15.4**	**16.2**	**6.3**	**42.6**	**0.6**	**1.2**
Brookfield	198	385	518	604	187	133	86	406	94.4	34.5	16.6	205.1	1.5	3.8
Wakefield	1,420	2,237	3,057	4,252	817	820	1,195	2,832	57.5	36.7	39.1	199.4	3.4	3.7
Subtotal Carroll Area	**1,618**	**2,622**	**3,575**	**4,856**	**1,004**	**953**	**1,281**	**3,238**	**62.1**	**36.3**	**35.8**	**200.1**	**3.1**	**3.7**
Study Area Total	**137,279**	**162,759**	**193,612**	**207,839**	**25,480**	**30,853**	**14,227**	**70,560**	**18.6**	**19.0**	**7.3**	**51.4**	**0.7**	**1.4**
County Totals														
Carroll County	18,548	27,931	35,410	43,666	9,383	7,479	8,256	25,118	50.6	26.8	23.3	135.4	2.1	2.9
Rockingham County	138,951	190,345	245,845	277,359	51,394	55,500	31,514	138,408	37.0	29.2	12.8	99.6	1.2	2.3
Strafford County	70,431	85,408	104,233	112,233	14,977	18,825	8,000	41,802	21.3	22.0	7.7	59.4	0.7	1.6

Source: US Census
NOTE: Towns listed within the counties are only those located within the socio-economic study area.

Table 3.10-2
Total Households and Household Size 1980-2000
Socio-Economic Study Area

	Total Households							Average Persons Per Household			
				Change		% Change				Change	% Change
	1980	1990	2000	80-90	90-00	80-90	90-00	1990	2000	90-00	90-00
Barrington	1,502	2,217	2,767	715	550	47.6	24.8	2.8	2.7	-0.10	-3.6
Dover	8,307	10,346	11,542	2,039	1,196	24.5	11.6	2.36	2.26	-0.10	-4.2
Durham	2,072	2,365	2,887	293	522	14.1	22.1	2.7	2.8	0.10	3.7
Farmington	1,579	2,067	2,134	488	67	30.9	3.2	2.77	2.69	-0.08	-2.9
Lee	751	1,278	1,469	527	191	70.2	14.9	2.92	2.81	-0.11	-3.8
Madbury	340	489	535	149	46	43.8	9.4	2.87	2.82	-0.05	-1.7
Middleton	247	398	526	151	128	61.1	32.2	2.97	2.74	-0.23	-7.7
Milton	808	1,301	1,440	493	139	61.0	10.7	2.84	2.72	-0.12	-4.2
New Durham	423	684	805	261	121	61.7	17.7	2.89	2.75	-0.14	-4.8
Rochester	7,703	10,196	11,397	2,493	1,201	32.4	11.8	2.58	2.47	-0.11	-4.3
Rollinsford	776	979	1,043	203	64	26.2	6.5	2.7	2.54	-0.16	-5.9
Somersworth	3,790	4,374	4,704	584	330	15.4	7.5	2.56	2.43	-0.13	-5.1
Subtotal Strafford Area	**28,298**	**36,694**	**41,249**	**8,396**	**4,555**	**29.7**	**12.4**	(X)	(X)	(X)	(X)
Brentwood	549	752	906	203	154	37.0	20.5	2.92	3.01	0.09	3.1
East Kingston	366	472	625	106	153	29.0	32.4	2.88	2.85	-0.03	-1.0
Epping	1,158	1,859	2,053	701	194	60.5	10.4	2.74	2.66	-0.08	-2.9
Exeter	4,215	5,025	5,900	810	875	19.2	17.4	2.43	2.32	-0.11	-4.5
Greenland	711	1,020	1,211	309	191	43.5	18.7	2.71	2.63	-0.08	-3.0
Hampton	4,118	4,992	6,474	874	1,482	21.2	29.7	2.43	2.28	-0.15	-6.2
Hampton Falls	466	532	711	66	179	14.2	33.6	2.83	2.64	-0.19	-6.7
Kensington	437	556	657	119	101	27.2	18.2	2.92	2.87	-0.05	-1.7
New Castle	338	341	413	3	72	0.9	21.1	2.16	2.42	0.26	12.0
Newfields	276	300	517	24	217	8.7	72.3	2.96	3	0.04	1.4
Newington	252	292	293	40	1	15.9	0.3	2.64	2.55	-0.09	-3.4
Newmarket	1,757	2,924	3,373	1,167	449	66.4	15.4	2.45	2.37	-0.08	-3.3

Table 3.10-2 (continued)

	Total Households							Average Persons Per Household			
				Change		% Change				Change	% Change
	1980	1990	2000	80-90	90-00	80-90	90-00	1990	2000	90-00	90-00
North Hampton	1,217	1,374	1,660	157	286	12.9	20.8	2.65	2.57	-0.08	-3.0
Portsmouth	9,498	10,311	9,933	813	-378	8.6	-3.7	2.4	2.03	-0.37	-15.4
Rye	1,737	1,918	2,174	181	256	10.4	13.3	2.38	2.35	-0.03	-1.3
Stratham	811	1,880	2,308	1,069	428	131.8	22.8	2.72	2.75	0.03	1.1
Subtotal Rockingham Area	**27,906**	**34,548**	**39,208**	**6,642**	**4,660**	**23.8**	**13.5**	(X)	(X)	(X)	(X)
Brookfield	139	205	239	66	34	47.5	16.6	2.82	2.53	-0.29	-10.3
Wakefield	856	1,195	1,682	339	487	39.6	40.8	2.61	2.53	-0.08	-3.1
Subtotal Carroll Area	**995**	**1,400**	**1,921**	**405**	**521**	**40.7**	**37.2**	(X)	(X)	(X)	(X)
Study Area Total	**113,403**	**143,884**	**162,835**	**30,481**	**18,951**	**26.9**	**13.2**	(X)	(X)	(X)	(X)
County Totals											
Carroll County	11,084	14,283	18,387	3,199	4,104	28.9	28.7	2.45	2.34	-0.11	-4.5
Rockingham County	66,471	89,259	104,586	22,788	15,327	34.3	17.2	2.72	2.63	-0.09	-3.3
Strafford County	28,856	37,688	42,531	8,832	4,843	30.6	12.9	2.6	2.5	-0.10	-3.8

Source: US Census
NOTE: Towns listed within the counties are only those located within the socio-economic study area.

Table 3.10-3
Average Home Sales Prices 1992-2002
Rockingham, Strafford and Seacoast Areas*

	Strafford Area			Rockingham Area			Seacoast Area		
	Avg. Sale Price	Total Units	Avg. DOM	Avg. Sale Price	Total Units	Avg. DOM	Avg. Sale Price	Total Units	Avg. DOM
1992	$84,543	782	128	$116,639	534	126	$135,342	615	101
1993	$82,302	1,012	140	$117,665	748	143	$143,471	749	116
1994	$87,093	1,085	138	$112,533	906	131	$149,979	940	115
1995	$83,287	942	148	$114,962	855	147	$155,568	961	129
1996	$92,232	1,129	234	$127,014	1,328	163	$166,787	938	181
1997	$100,309	1,368	180	$133,946	1,501	254	$182,548	1,065	202
1998	$106,774	1,469	167	$147,217	2,017	162	$193,916	1,271	226
1999	$120,648	1,722	138	$163,313	1,940	142	$213,261	1,307	136
2000	$140,265	1,579	118	$188,096	1,794	129	$243,935	1,310	126
2001	$166,041	1,546	119	$209,932	1,823	121	$268,943	1,196	127
2002	$185,626	1,699	119	$240,937	1,836	126	$299,319	1,296	123
Change 92-02	**$101,083**			**$124,298**			**$163,977**		
% Change	**119.6%**			**106.6%**			**121.2%**		
Avg. Annual	**8.2%**			**7.5%**			**8.3**		

Source: NH Association of Realtors

DOM = Days on Market

* Strafford Area includes: Barrington, Brookfield, Dover, Durham, Farmington, Lee, Madbury, Middleton, Milton, New Durham, Rochester, Rollinsford, Somersworth, Strafford, Union. Rockingham Area includes: Atkinson, Brentwood, Danville, East Kingston, Epping, Exeter, Fremont, Hampstead, Kensington, Kingston, Newfields, Newton, Nottingham, Plaistow, Raymond, Sandown, South Hampton and Stratham. Seacoast Area includes: Greenland, Hampton, Hampton Falls, New Castle, Newington, Newmarket, North Hampton, Portsmouth, Rye, and Seabrook.

Table 3.10-4
Median Monthly Gross Rent 1993-2003
Socio-Economic Study Area and the Cities of Rochester and Portsmouth

Median Gross Rent – 2003						
# Bedrooms	**Study Area**	**Carroll County**	**Strafford County**	**Rockingham County**	**City of Rochester**	**City of Portsmouth**
0	$563	NA	$580	$555	NA	NA
1	$731	$556	$719	$776	$682	$842
2	$899	$729	$857	$1,009	$837	$1,071
3	$1,148	$929	$1,043	$1,280	$939	$1,280
4+	$1,430	NA	$1,304	NA	NA	NA
All	$844	$650	$789	$939	$771	$1,071
Change in Gross Rent for a Two Bedroom Unit 1993-2003						
Rent 1993	$564	$532	$543	$631	$685	$584
Rent 2003	$899	$729	$857	$1,009	$837	$1,071
Change 93-03	$335	$197	$314	$378	$152	$487
% Change	59.4%	37.0%	57.8%	59.9%	22.2%	83.4%
Annual Change	4.8%	3.2%	4.7%	4.8%	2.0%	6.3%

Source: 2003 Residential Rental Cost Survey, NH Housing Finance Authority.

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3.10.3 Local Land Use

The composition of the existing land use (**Tables 3.10-5 and 3.10-6**) varies dramatically between the Newington and Dover portions of the study area. Newington's portion of the study area is heavily industrialized and also includes a substantial amount of commercial development, as well as a residential component. Conversely, Dover's existing land use within the study area is comprised almost entirely of residential development along with a few scattered commercial and office facilities.

The Newington portion of the study area has 72 dwelling units and 143 properties classified as non-residential, including 26 vacant parcels. The commercial and industrial properties contain over 2.7 million square feet of building space. There is an estimated 114 acres of undeveloped land remaining in the commercial and industrial zoning areas. The largest contiguous block of this undeveloped land is owned by Public Service Company of New Hampshire, which controls approximately 82 acres. The total assessed value of all properties in the Newington portion of the study area is approximately $468.6 million, which represents approximately 84.6% of the town's total taxable valuation.

Table 3.10-5
Property Inventory - Town of Newington Study Area

	RESIDENTIAL					
Type of Property	# Properties	# Units	Acreag	Assessed Value Land	Building	Total
Single Family	61	61	127	$5,064,604	$4,873,255	$9,937,859
2-3 Family	5	11	5	$366,830	$468,300	$835,130
Vacant*	8	0	108	$464,582	$46,100	$510,682
Total	**74**	**72**	**240**	**$5,896,016**	**$5,387,655**	**$11,283,671**

	NON-RESIDENTIAL					
Type of Property	# Properties	Bldg. Sq. Ft.	Acreage	Assessed Value Land	Building	Total
Retail/Service	20	1,741,547	203	$36,264,391	$89,211,841	$125,476,232
Restaurant/Lodging	5	56,789	17	$3,324,368	$2,797,880	$6,122,248
Office	4	67,941	16	$2,774,489	$3,435,794	$6,210,283
Warehouse	8	248,219	27	$3,329,147	$7,958,303	$11,287,450
Industrial**	76	558,723	234	$41,516,619	$249,983,502	$291,500,121
Other Commercial	2	29,888	9	$584,138	$1,632,991	$2,217,129
Institutional	2	65,898	34	$1,888,128	$1,495,033	$3,383,161
Vacant	26	0	114	$11,114,188	$0	$11,114,188
Total	**143**	**2,769,005**	**654**	**$100,795,468**	**$356,515,344**	**$457,310,812**

Source: Town of Newington assessment records, September 2003
* There is some building value on vacant land due to several properties that have minor structures/improvements but no residences.
** The building square footage of industrial structures does not contain several of the larger power plant and manufacturing facilities because this information was not available in town assessment records at the time this report was prepared.

Table 3.10-6
Property Inventory - City of Dover Study Area

	RESIDENTIAL					
Type of Property	# Properties	# Units	Acreage	Assessed Value Land	Assessed Value Building	Assessed Value Total
Single Family	462	462	159	$27,432,000	$27,088,100	$54,520,100
Mobile Homes	2	18	2	$232,900	$656,200	$889,100
Condominiums	3	130	35	$6,311,500	$11,849,300	$18,160,800
2-3 Family	5	11	4	$605,400	$649,800	$1,255,200
4 Family	2	8	2	$448,700	$415,100	$863,800
Vacant	9	0	22	$1,061,800	$0	$1,061,800
Total	**483**	**629**	**224**	**$36,092,300**	**$40,658,500**	**$76,750,800**

	NON-RESIDENTIAL					
Type of Property	# Properties	Bldg. Sq. Ft.	Acreage	Assessed Value Land	Assessed Value Building	Assessed Value Total
Retail/Service	2	15,597	2	$369,400	$532,800	$902,200
Restaurant/Lodging	1	871	1	$337,900	$962,000	$1,299,900
Office	2	4,579	1	$135,900	$158,700	$294,600
Other Commercial	2	7,796	2	$433,500	$157,300	$590,800
Municipal	3	960	4	$312,700	$148,700	$461,400
State	5	2,556	35	$2,330,900	$341,100	$2,672,000
Vacant	3	0	3	$94,400	$0	$94,400
Total	**18**	**32,359**	**48**	**$4,014,700**	**$2,300,600**	**$6,315,300**

Source: City of Dover Assessment Records 2003

The Dover portion of the study area contains 629 dwelling units. Approximately 75% (462) of these units are single family dwellings and 21%, or 130 units, are condominiums. There are also 18 mobile homes in the study area, almost all of which are located in a small mobile home park which is adjacent to the Turnpike. Approximately 25 acres are classified as undeveloped land. The assessed value of residential land and buildings in the Dover portion of the study area is approximately $76.7 million. Although non-residential development has an assessed value of approximately $6.3 million, almost half of that amount ($3.1 million) is non-taxable since it is in public ownership. The combined assessed value of taxable property in the Dover portion of the study area is approximately $79.9 million which represents 4.3% of the city's $1.85 billion in net assessed value as of 2003.

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3.10.4 Commuting Patterns

A review of journey-to-work commuting data (Tables 3.10-7 and 3.10-8) shows that approximately 76% (82,699) of all workers living in the socio-economic study area are

also employed at businesses located within the socio-economic study area. This indicates that there is a strong internal movement of socio-economic study area residents to employment activities located within the socio-economic study area. In Strafford County, the number of residents working outside the county increased by approximately 20% between 1990 and 2000. The largest portion of this increase represented workers going to Rockingham County which received approximately 65% of all outbound commuters from Strafford County as of 2000. There was a decrease in the number of Strafford County residents commuting to Maine during the decade which may be attributable to the reduction in workforce at the Portsmouth Naval Shipyard in Kittery, Maine.

The Portsmouth-Rochester Metropolitan area has become much more integrated from an economic perspective, particularly within the last 10 years. Commuting patterns show that over three quarters of all people living in the metropolitan study area also work within the area. This transportation linkage is especially prevalent amongst residents of Strafford County, many of whom commute south to jobs located in Rockingham County. While this trend is also true for residents of the Rockingham County portion of the metropolitan area, there is a somewhat higher percentage of people living in Rockingham County that commute outside the socio-economic study area to employment locations in Massachusetts and elsewhere in New Hampshire.

There are two major factors that have helped to shape the commuting patterns mentioned above. The first is that a substantial portion of the business and job growth in the metropolitan study area has occurred within Rockingham County. This observation is illustrated by the closure of the Pease Air Force Base and its redevelopment as the Pease International Tradeport in Portsmouth/Newington, where the number of jobs created since 1990 accounts for approximately 20% of the net job growth over the last decade within the socio-economic study area. Combined with this higher job growth in the southern tier is a commensurate increase in the cost of housing. Housing costs in Rockingham County have remained consistently higher than those in Strafford and Carroll Counties over the last decade. This fact has attracted sustained residential growth to the northern portion of the socio-economic study area, which has supported an expanding workforce of commuters who require access to the regional transportation system.

Table 3.10-7
Place of Work for Workers 16 Years and Over - 2000
Socio-Economic Study Area

Place of Residence	Worked in Study Area	Worked Outside Study Area	Total	% Total In Study Area	% Total Outside Study Area
Barrington	3,370	822	4,192	80.4	19.6
Dover	12,422	2,600	15,022	82.7	17.3
Durham	4,928	930	5,858	84.1	15.9
Farmington	2,257	484	2,741	82.3	17.7
Lee	1,730	609	2,339	74.0	26.0
Madbury	687	116	803	85.6	14.4
Middleton	548	202	750	73.1	26.9
Milton	1,625	320	1,945	83.5	16.5
New Durham	782	377	1,159	67.5	32.5
Rochester	12,571	1,890	14,461	86.9	13.1
Rollinsford	1,179	302	1,481	79.6	20.4
Somersworth	4,733	988	5,721	82.7	17.3
Subtotal Strafford Area	**46,832**	**9,640**	**56,472**	**82.9**	**17.1**
Brentwood	815	577	1,392	58.5	41.5
East Kingston	407	554	961	42.4	57.6
Epping	1,964	1,074	3,038	64.6	35.4
Exeter	5,000	2,322	7,322	68.3	31.7
Greenland	1,391	307	1,698	81.9	18.1
Hampton	4,504	3,282	7,786	57.8	42.2
Hampton Falls	515	464	979	52.6	47.4
Kensington	461	552	1,013	45.5	54.5
New Castle	339	113	452	75.0	25.0
Newfields	573	231	804	71.3	28.7
Newington	339	122	461	73.5	26.5
Newmarket	3,729	1,204	4,933	75.6	24.4
North Hampton	1,628	632	2,260	72.0	28.0
Portsmouth	8,908	2,869	11,777	75.6	24.4
Rye	1,584	732	2,316	68.4	31.6
Stratham	2,253	867	3,120	72.2	27.8
Subtotal Rockingham Area	**34,410**	**15,902**	**50,312**	**68.4**	**31.6**
Brookfield	162	131	293	55.3	44.7
Wakefield	1,295	695	1,990	65.1	34.9
Subtotal Carroll Area	**1,457**	**826**	**2,283**	**63.8**	**36.2**
Study Area Total	**82,699**	**26,368**	**109,067**	**75.8**	**24.2**

Source: US Census

Table 3.10-8
Change in County-to-County Commuting Patterns 1990 and 2000
Strafford, Rockingham and Carroll Counties

Residents Commuting From: Strafford County	1990	2000	% Total	Change	% Change
Residents Working in County	32,488	34,364	58.84	1,876	5.8
Residents Commuting Out	20,047	24,039	41.16	3,992	19.9
Total	52,535	58,403	100.00	5,868	11.2
Commuting To:					
Belknap County	205	371	1.54	166	81.0
Carroll County	325	376	1.56	51	15.7
Hillsborough County	870	1,146	4.77	276	31.7
Merrimack County	671	1,193	4.96	522	77.8
Rockingham County	11,343	15,537	64.63	4,194	37.0
Other New Hampshire	153	110	0.46	-43	-28.1
Maine	4,421	2,825	11.75	-1,596	-36.1
Massachusetts	1,578	2,104	8.75	526	33.3
Other Outside NH	481	377	1.57	-104	-21.6

Commuting To Jobs In: Strafford County	1990	2000	% Total	Change	% Change
Residents Working in County	32,488	34,364	73.92	1,876	5.8
Nonresidents Commuting In	10,781	12,125	26.08	1,344	12.5
Total	43,269	46,489	100.00	3,220	7.4
Commuting From:					
Belknap County	463	460	3.79	-3	-0.6
Carroll County	581	1,125	9.28	544	93.6
Hillsborough County	235	496	4.09	261	111.1
Merrimack County	309	507	4.18	198	64.1
Rockingham County	4,060	4,254	35.08	194	4.8
Other New Hampshire	108	86	0.71	-22	-20.4
Maine	4,440	4,467	36.84	27	0.6
Massachusetts	455	511	4.21	56	12.3
Other Outside NH	130	219	1.81	89	68.5

Rockingham County	1990	2000	% Total	Change	% Change
Residents Working in County	67,438	78,659	52.90	11,221	16.6
Residents Commuting Out	64,087	70,044	47.10	5,957	9.3
Total	131,525	148,703	100.00	17,178	13.1
Commuting To:					
Belknap County	163	137	0.20	-26	-16.0
Carroll County	34	155	0.22	121	355.9
Hillsborough County	13,088	16,816	24.01	3,728	28.5
Merrimack County	2,277	3,753	5.36	1,476	64.8
Strafford County	4,060	4,254	6.07	194	4.8

Rockingham County	1990	2000	% Total	Change	% Change
Residents Working in County	67,438	78,659	61.42	11,221	16.6
Nonresidents Commuting In	33,539	49,402	38.58	15,863	47.3
Total	100,977	128,061	100.00	27,084	26.8
Commuting From:					
Belknap County	372	511	1.03	139	37.4
Carroll County	170	458	0.93	288	169.4
Hillsborough County	6,326	11,259	22.79	4,933	78.0
Merrimack County	1,254	2,496	5.05	1,242	99.0
Strafford County	11,343	15,537	31.45	4,194	37.0

Table 3.10-8 (continued)

Residents Commuting From:	Strafford County					Commuting To Jobs In:	Strafford County				
	1990	2000	% Total	Change	% Change		1990	2000	% Total	Change	% Change
Other New Hampshire	237	235	0.34	-2	-0.8	Other New Hampshire	171	190	0.38	19	11.1
Maine	2,689	1,713	2.45	-976	-36.3	Maine	5,844	7,728	15.64	1,884	32.2
Massachusetts	40,179	41,689	59.52	1,510	3.8	Massachusetts	7,575	10,500	21.25	2,925	38.6
Other Outside NH	1,360	1,292	1.84	-68	-5.0	Other Outside NH	484	723	1.46	239	49.4
	Carroll County						**Carroll County**				
Residents Working in County	13,446	15,816	76.09	2,370	17.6	Residents Working in County	13,446	15,816	81.85	2,370	17.6
Residents Commuting Out	3,153	4,969	23.91	1,816	57.6	Nonresidents Commuting In	2,661	3,508	18.15	847	31.8
Total	16,599	20,785	100.00	4,186	25.2	Total	16,107	19,324	100.00	3,217	20.0
Commuting To:						**Commuting From:**					
Belknap County	839	1,239	24.93	400	47.7	Belknap County	414	581	16.56	167	40.3
Coos County	188	172	3.46	-16	-8.5	Coos County	193	303	8.64	110	57.0
Merrimack County	201	240	4.83	39	19.4	Merrimack County	62	99	2.82	37	59.7
Rockingham County	170	458	9.22	288	169.4	Rockingham County	34	155	4.42	121	355.9
Strafford County	581	1,125	22.64	544	93.6	Strafford County	325	376	10.72	51	15.7
Other New Hampshire	226	349	7.02	123	54.4	Other New Hampshire	123	221	6.30	98	79.7
Maine	431	422	8.49	-9	-2.1	Maine	1,340	1,644	46.86	304	22.7
Massachusetts	404	636	12.80	232	57.4	Massachusetts	106	75	2.14	-31	-29.2
Other Outside NH	113	328	6.60	215	190.3	Other Outside NH	64	54	1.54	-10	-15.6

Source: US Census

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3.10.5 Environmental Justice

In accordance with Executive Order 12898 and subsequent procedures developed by the USDOT, activities that have the potential to generate a disproportionately high and adverse effect on human health or the environment shall include explicit consideration of their effects on minority populations and low income populations. In making an assessment of whether or not Environmental Justice has been served, information regarding race, color or national origin, and income level should be obtained where relevant, appropriate and practical. Specific consideration should be given to those populations which are most directly served or affected by the proposed action.

In order to evaluate potential Environmental Justice impacts of the Project Alternatives, 2000 Census data has been collected at the Block Group (BG) level for the portion of the study area in Dover, Newington, and Portsmouth that have the potential to be directly impacted by transportation system improvements. There are eight Block Groups for which data was gathered to examine potential disproportionate impacts on areas of racial minorities and low income individuals. Overall, these eight BGs had an average minority population of 3.8% which was slightly higher that the study area's 3.4% average. From an income perspective, the eight BGs had an average poverty rate of 7.1% in 2000 as compared to 7.6% for the study area as a whole.

Several of these Block Groups are the location of subsidized housing for low income residents which contributes to the higher rates of poverty in those areas. In Portsmouth, off Gosling Road, is Gosling Meadows, a HUD supported housing project, which contains 124 housing units occupied by low income families. The project is fully occupied at this time and there are no plans for expansion.

The other subsidized housing in the study area is the Great Bay School which is located on Woodbury Avenue in Newington. This facility provides vocational training for developmentally disabled individuals and operates a group residential home on the site which contains 12 single occupancy rooms that are fully occupied. The facility also provides training for approximately 100 developmentally disabled individuals who do not reside at the school.

3.11 Community Environment

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3.11.1 Municipal/Public Facilities

Newington

The only public building in Newington within the study area is the Newington School, located on Nimble Hill Road just west of the Coleman Drive intersection. This is an elementary school with an enrollment of approximately 60 students in grades Kindergarten through six. Three other facilities, the Newington Town Hall, including the fire and police stations, Langdon Public Library, and a cemetery, are all located just west of the study area along Nimble Hill Road. There is also a Town-owned boat landing located at the end of Patterson Lane on the Piscataqua River.

There is one State facility in Newington within the study area: the NH Air National Guard Station located at the Pease International Tradeport along Arboretum Road. A portion of the grounds of the Veterans Affairs Portsmouth Outpatient Clinic, a federal facility, is also located within the Tradeport, immediately adjacent to the study area on Newmarket Street.

Dover

There are three publicly owned facilities in Dover within the study area: the Town's Bayview Park, between Spur Road and the Bellamy River, the State's Hilton Park at Dover Point (see below for description of these two parks), and a NH Motor Vehicle Registry Office on Boston Harbor Road.

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3.11.2 Parks, Recreation, and Conservation Lands

Information on public parks, recreation areas, and conservation lands was obtained through field reconnaissance, interviews with City of Dover and Town of Newington officials, and the OSP. Potential impacts of USDOT funded projects on publicly owned parks and recreation areas, waterfowl and wildlife refuges and privately or publicly-owned historic resources must be addressed under the Section 4(f) provision of the National Transportation Act of 1966.

In addition, properties which have received funding under the Land and Water Conservation Fund Act (LWCF), as administered by the United States Department of Interior (USDOI), require special evaluation including specific requirements for mitigation under Section 6(f) of the LWCF.

NH law under RSA 4:30-a requires that impacted municipally-owned recreation or conservation lands be replaced. The RSA states that when the State of New Hampshire

acquires any municipal conservation or recreation land, it shall transfer to the affected municipality other comparable land and facilities to the extent feasible, or shall grant to the municipality sufficient funds to acquire comparable lands.

In addition, the New Hampshire Land Conservation Investment Program (LCIP), under NH RSA 162-C:6 is responsible for monitoring the condition and status of 80 state held conservation easements (approximately 25,880 acres) acquired by the LCIP during the late 1980's and early 1990's. Coordination with the NHOSP and the Council on Resources and Development (CORD) is necessary if the Department needs to acquire any such properties for highway purposes. Review of the study area by NHOSP staff indicates that no LCIP properties are present within the study area.

3.11.2.1 Recreational Section 4(f) Properties

Under Section 4(f) of the Department of Transportation Act as amended by the Federal-Aid Highway Act of 1968 (Public Law 90-495, 49 USC 1653), the Secretary of Transportation shall not approve any program or project which "requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance as so determined by Federal, State, or local officials having jurisdiction thereof, or any land from a historic site of national, state or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreation area, wildlife and waterfowl refuge, or historic site resulting from such use."

Newington

The only potential Section 4(f) resource in Newington within the study area is the Town Boat Landing at the end of Patterson Lane, a publicly-owned recreational site maintained by the Town of Newington.

Dover

There are two Section 4(f) properties in the Dover portion of the study area, both state owned: Hilton Park located on Dover Point and Bayview Park located between Spur Road and the Bellamy River. Hilton Park was created in 1934-1935 when the General Sullivan Bridge was being constructed. It contains a public fishing pier and boat launch, mowed lawns and picnic area, playground, parking lot, and a one-way interior road that wraps around the Point from east to west. The park property is also an historical resource (see Section 3.13).

Bayview Park is managed by the NHF&GD and is listed by them as the Bellamy River public-access site. It is a popular spot for fishermen to gain access to the

shoreline of the Bellamy River adjacent to the Scammel Bridge. There is a small parking area but it is for "cartop" boats only, *i.e.*, there is no ramp for trailers.

3.11.2.2 Section 6(f) Properties

Section 6(f) lands are defined as lands that have been acquired or improved with funds provided by the Federal Land and Water Conservation Fund Act. The U.S. Department of the Interior, National Park Service has jurisdiction over these lands. Section 6(f) lands cannot be converted to another use without replacement by land that is of comparable value and use. The NH Department of Resources and Economic Development (DRED), Division of Parks and Recreation, maintains a list of lands acquired or improved with Land and Water Conservation Funds in New Hampshire. A review of DRED's files indicate that there are no Section 6(f) properties within the study area

3.12 Aesthetic and Visual Resources

At the project's Scoping Meeting, comments were received that described the Spaulding Turnpike through the study area as the veritable "gateway" to New Hampshire's north country. Starting at the south end of the study area in Newington and traveling northward, the view from the highway to the east includes a highly commercialized landscape, including several shopping plazas and malls. Blocks of natural vegetation and highway landscaping provide some screening. However, just south of the Little Bay Bridges, one gets a very picturesque and panoramic view of mountains in the distance and the arched General Sullivan Bridge and Little Bay Bridges in the foreground. Approaching and then crossing over the northbound Little Bay Bridge, one has an exceptional view of the broad waters of the Piscataqua River and Hilton Park. In the summer months, the manicured lawns of Hilton Park and its pier, as well as boats in the river, provide a very scenic viewscape.

Crossing over the northbound Little Bay Bridge, the two-lanes of traffic of the southbound bridge and superstructure of the General Sullivan Bridge partially block the view of Little Bay to the west. Reaching Dover Point, the natural vegetation in the highway median dominate the viewshed. Also visible are residential homes lining both shorelines of Dover Point to the west and east. Continuing northward, the multiple lanes of highway, including the Exit 6 ramps for US 4 and Dover Point Road, begin to dominate the view from the roadway; small blocks of forested areas are visible within the interchange and immediately adjacent to the highway. Continuing on to the toll plazas, a line of trees provides an effective screen on both sides of the highway.

In the southbound direction, the views are as described above with the exception that the extensive shoreline and waters of Little Bay are more readily visible in the distance as one approaches and then crosses the Little Bay Bridge. On the bridge itself, one's view is again partially obstructed by the superstructure of the General Sullivan Bridge. Continuing southward into Newington, the view along the west side of the Turnpike is once again dominated by natural vegetation, including mowed highway areas. Other features include the convenience/service station at Nimble Hill Road, a field in the center of the median area, an abandoned drive-in theatre site now grown over into a shrubland and young forest; and a practically uninterrupted block of forest all the way to Exit 1. This view is in stark contrast to the views on the east side of the highway, previously described.

Relative to views of the highway from residential neighborhoods, homes along streets on the eastern side of Dover Point are today largely screened by natural vegetation. On the western side of Dover Point, views from homes on Boston Harbor Road are either screened by blocks of forest or mature trees in their front yards. On the Newington end, residential neighborhoods are far removed from the highway. East of the Turnpike, they are separated from it by commercial/industrial developments located along the highway. West of the Turnpike, views from the Nimble Hill Road neighborhood are screened by natural vegetation and the commercial establishments near its intersection with the Turnpike.

3.13 Cultural Resources

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3.13.1 Regulatory Overview

3.13.1.1 Federal Requirements

Historic properties and archaeological resources, that are listed in or are eligible for listing in the National Register of Historic Places, are afforded protection by Section 106 of the National Historic Preservation Act (NHPA) and Section 4(f) of the Department of Transportation Act of 1966.

National Historic Preservation Act

Congress enacted the NHPA, as amended, in 1966 to ensure that the effects of federal, federally funded, or federally permitted projects on historic buildings, neighborhoods, landscapes, and archaeological sites are considered. Through the NHPA, amended in 1976, 1980, and 1992, Congress sought to involve the federal government as an active participant in the Nation's preservation efforts.

Section 106 of the NHPA requires federal agencies to take into account the effects of their activities and programs on any historic district, site, building, structure, or

object that is included, or eligible for inclusion, in the National Register of Historic Places. The resources and the effects on those resources are evaluated by the State Historic Preservation Officer (SHPO) and the federal agencies having jurisdiction, in this case the Federal Highway Administration (FHWA), the lead agency. In New Hampshire, the SHPO is the director of the New Hampshire Division of Historical Resources (NHDHR). Prior to the approval of the undertaking, the agency must afford the Advisory Council on Historic Preservation (ACHP), established under Title II of the NHPA, a reasonable opportunity to comment on the undertaking.

The procedures followed in the Section 106 review are referred to as the "Section 106 process" and are set forth in regulations issued by the ACHP. The ACHP's regulations, *Protection of Historic Properties* (36 CFR 800) govern the Section 106 process. The ACHP does not have the authority to halt or terminate projects that will affect historic properties; rather, its regulations emphasize consultation among the responsible federal agencies, and other interested, consulting parties, to identify, evaluate eligibility, determine the potential effect of the project on historic properties, and if possible, to agree upon ways to protect the affected properties through avoidance and/or through minimization or mitigation of the effects.

Opportunities for Public Participation Under Section 106

In addition to the participation of Federal and State agencies in the Section 106 review process, the 1999 regulations at 36 CFR 800 require that the federal agencies consult with the public about the projects and their effects on historic properties. The segment of the public specifically involved in the consultation process under these regulations generally includes immediately affected property owners; local and statewide historical, archaeological, preservation, heritage, and planning organizations; and the Native American community. It is the responsibility of the lead federal agency to provide adequate opportunity for these groups to receive information on the project and share their views. Typically, those individuals and organizations request consulting party status in writing from FHWA, and receive notification of their consulting party status. Consulting parties are notified of public meetings involving the project and meetings set to specifically discuss historical issues related to the project. Such parties are frequently provided minutes of these meetings. The comments from consulting parties involving historical properties are taken into account during the design stage.

In addition, the information on historical properties developed by state and federal agencies for this project is available to the community, citizens, and local officials, to enact ordinances protecting historic properties. The material can also be incorporated into the community master plan to identify historical resources and preserve them for future enrichment of the community.

Section 4(f) of the Department of Transportation Act

Section 4(f) of the Department of Transportation Act of 1966 (49USC 303) states that "…special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic

sites." Regulations governing 4(f) implementation specify that there can be no taking of public-park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible alternatives. Such alternatives may range from project modifications to "no-build." If it is determined that no prudent and feasible alternative exists and that public park or recreational lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation of other alternatives would result in extraordinary costs, and/or social, economic, or environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to these historic properties and other resources.

3.13.1.2 State Requirements

The NHDHR is charged under RSA 227-C:9, *Directive for Cooperation in the Protection of Historic Resources*, to coordinate the identification and evaluation of cultural resources in the State of New Hampshire.

The NHDHR, in cooperation with the NHDOT and FHWA, has established a method of identification and evaluation to meet the requirements of historic preservation review, a responsibility established under RSA 227-C:9. The purposes of this process are to (1) locate and identify historical, architectural, archaeological, and historical archaeological resources within the project's impact area; (2) apply the criteria for evaluation of significance to a resource to determine possible eligibility to the National Register of Historic Places (National Register), if not already eligible or listed; (3) assess the probable effects of a project on resources listed on or eligible for, the National Register; and (4) avoid historic properties and/or develop appropriate mitigation methods to lessen the project's impact on affected historic properties.

The NHDHR prepared *Procedures for Identifying Cultural Resources That May Be Affected by State or Federal Transportation Projects in New Hampshire* in November 1992. These procedures were updated in 2001 and 2003. This document offers specific guidance for cultural resource survey efforts undertaken as a component of transportation improvement projects.

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3.13.2 Historic/Architectural Resources

3.13.2.1 Methods and Procedures

A review of potentially historic properties (built before *ca.* 1955) was conducted in the summer and fall of 2003. Every property over fifty years old was identified and mapped. Photographs were taken for the NHDHR Project Area Form, which also includes a map showing photograph locations and prior survey activity.

Figure 3.13-1 shows all properties within the study area that are known to be more than fifty years old, and are identified on the figure as Potentially Historic. Four properties in the study area have previously been determined eligible for or were listed on the National Register, and are therefore identified on the base map as Historic (H).

The first listed property is the Louis C. DeRochemont Mansion in Newington, determined eligible (10/28/98) under Criteria B and C, for its association with nationally-recognized filmmaker Louis C. DeRochemont and as a locally significant example of a Greek Revival style dwelling remodeled with Colonial Revival style elements. (This determination was made as part of the Joint Pipeline Project in 1998). A second listed site, the First Parish Church site (5/27/83), is on Dover Point Road in Dover and is located at the northern limits of the study area. The two other resources that have been determined eligible for the National Register are the General Sullivan Bridge and the Railroad Depot/Toll House at Bloody Point. The General Sullivan Bridge was built in 1935; it is an excellent example of a continuous steel truss bridge. The Depot/Toll House was built c.1873; it is a simple 2-1/2 story, frame structure, with a high degree of integrity.

3.13.2.2 Historical Background

Although humans have lived in the area for over ten thousand years, the first European settlement in the region dates from 1623. During the next one hundred years, this section of what later became known as New Hampshire, was divided into four great "towns" or plantations of Portsmouth, Dover, Exeter and Hampton. Until 1680, this area was part of the Massachusetts Bay Colony. (Monroe, *et al*. 1999).

Due to its pivotal location and natural resources of lumber and clay, Dover Point is historically significant for every period of the region's settlement and development. Dover Point along with Odiorne Point in Rye was the first areas of European settlement in New Hampshire. Dover Point later served as a transportation and shipbuilding center, as the site of farming and extensive brick manufacturing, as the land and rail transportation corridor between the state's only seaport and the interior, as a summer cabin and hotel community, as a state park, and finally as the location of the Spaulding Turnpike (a four- to six-lane highway that links I-95 with the recreational opportunities of the White Mountain and lakes regions). Each successive layer of history has partially erased the historical significance of earlier periods, and today the evidence of each layer is scattered (Monroe 1998).

Newington began as a strong agricultural settlement, remaining so into the twentieth century. A solid industrial base did not take hold until the First World War at which time the eastern shore of the town began its transformation, which continues today, in the heavy industrial and manufacturing businesses drawn to the area for its deep

ports and accessibility to the water. Newington has also attracted a large amount of commercial development near the Newington/Portsmouth town line.

1623-1775: Settlement, lumber industry, water and land transportation
The first European settlement in the region dates from 1623 when Edward and William Hilton constructed houses, planted corn fields and traded with Native Americans at Dover Point (Monroe 1990). Located in the center of the confluence of the five tributaries of the navigable Piscataqua River, Dover Neck was the natural hub of activity from all points inland as the area was settled. Wharves were built at Pomeroy Cove, the site of immigrant landings from 1623-1633 (Hayes 1915). Pomeroy Cove was also home to Edward Hilton's salmon and cod fishing and drying operations. In 1633, following a scouting trip to the area in 1631 and the acquisition of Hilton's business interests, Captain Thomas Wiggin arrived in Dover with a group of settlers from Salem, Massachusetts. Some families were Puritans and some were entrepreneurs. This early village, located just north of Pomeroy Cove, supported itself primarily by fishing, lumbering and farming. The new group formed the First Parish Church of Dover in 1638 and built a meetinghouse near the site of the present toll plaza on the Spaulding Turnpike (Monroe, *et al.* 1999).

Further inland, the falls of the Cocheco River offered water-power for saw mills, and by 1700 Dover's center of settlement had shifted to its current location. Lumber was a lucrative business during the first hundred years of settlement as Boston was expanding and London was re-building. Dover, as well as Newington, became a natural center because surrounding areas were being cleared for farming and the rivers provided natural power for sawmills and easy transportation to Portsmouth. In 1713, a new, more centrally located meetinghouse was built on Pine Hill on the south side of what is now the downtown. Early prominent Dover families were granted land and water privileges on the falls of inland rivers. Lumber mills were established and the lumber from these mills was shipped to Dover Point for transport for building in Boston, Portsmouth and Britain (Monroe 1990). Shipbuilding was a natural outgrowth of the lumber industry, and prior to 1650 a frigate was built on the west bank of the Fore River (Scales 1923).

The surrounding river and bays, which made the area accessible by water, determined the locations of Newington's first European settlements. The earliest was on Bloody Point, a name subject to controversy as to whether it was named after a fight between the king's agents vying for the land, or refers to a Native American massacre that took place around 1690 (Hurd 1882). The town began as a small agricultural and manufacturing community, with farmland and water-powered mills the predominant landscape features. The abundance of lumber in Newington made it a prime source of shipbuilding material. The earliest known mill, built by Mr. Swanden in 1623, operated on a tidal stream known today as Mill Brook in the southwestern portion of the town.

The land area of Newington was originally granted as part of Dover. But due to the difficulty of crossing the river to attend church services there, it was "set off" as a

New Hampshire DOT
Department of Transportation

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- POTENTIALLY HISTORIC STRUCTURE
- (H) HISTORIC STRUCTURE (LISTED OR ELIGIBLE FOR LISTING)

PORTSMOUTH
NEWINGTON
DURHAM
ROCKINGHAM COUNTY
STRAFFORD COUNTY
LITTLE BAY
PEASE BLVD
GOSLING RD
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
FOX POINT RD
FLAGSTONE BROOK
TRICKY'S COVE
NIMBLE HILL RD
FOX RUN RD
WOODBURY AVE
RIVER RD
BLOODY POINT
DOVER POINT
BOSTON HARBOR RD
POMEROY COVE
ROYALS COVE
SPUR RD
BELLAMY RIVER
TOLL PLAZA
HOMESTEAD LN
DOVER POINT RD
SHATTUCK WAY
UNNAMED PONDS
PATTERSON LN
GUILFORD RR NEWINGTON BRANCH
PISCATAQUA RIVER
NEWINGTON
DOVER
PAUL BROOK
UNNAMED PERENNIAL STREAM
NEW HAMPSHIRE
MAINE

0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.13-1
Historical Resources

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separate parish known as Bloody Point in 1712. That year a meetinghouse was erected on what was to become Newington Parish, now said to be the oldest in continuous use in the state. Shortly thereafter, the first town meeting was held and the citizens favored incorporation as a town. In 1714 incorporation status was granted, and the parish name was changed from Bloody Point to Newington (Strafford Rockingham Regional Council 1981).

The Piscataqua River and Great Bay offered some transportation advantages, but as settlers moved inland, north and westward, these bodies of water also served to isolate much of the interior from the developed coastal cities. Early on, the only method of crossing the inland tributaries of the Piscataqua River was by ferry or small pile bridges erected far enough upstream to permit construction with available technology (Chesley 1984:22). Bloody Point was an important ferry crossing (Chesley 1984:23).

Early roads in Newington and Dover connected vital water crossings with the inland settlements. The study area is centered on one of the earliest water crossings in the State, with ferry service starting at Bloody Point in 1640 and continuing until the arrival of the railroad in the nineteenth century. Early roads include Dover Point Road, running north-south from the Dover center along Dover Neck, and Old Dover Road and River Road in Newington running north-south in the approximate location of the Spaulding Turnpike.

1775-1820: Improvements in Transportation, Agrarian Economy, The First Recorded Brickyards

In 1794, private investors funded the construction of the Piscataqua Bridge to alleviate the transportation problems within the state. Transportation problems within the State had been exacerbated around the end of the eighteenth century as inland settlement, particularly along the Merrimack River, rapidly developed. To more equally serve the growing State, the State capitol had moved from Exeter to Concord by 1805. Newburyport, Massachusetts, drew inland commerce and trade from Portsmouth, which was accessible from the interior only by poor overland routes and ferries over Great and Little Bays. The Piscataqua Bridge, from Fox Point in Newington across to Durham, was the largest bridge in the country at the time (Chesley 1984). The crossing site was chosen because of the central location of Goat Island and the lesser currents than at Bloody Point. For Newington, the construction of the bridge, which eventually led to the First New Hampshire Turnpike, was an important impetus for growth and increased mobility. The Bloody Point Ferry continued to operate across the Piscataqua River to Maine (Monroe 1998).

Newington's superior topographical and geological characteristics made agriculture the dominant occupation during this period. Agricultural prosperity is indicated by the construction and remodeling of numerous federal style farmhouses, many of which remain today. There was little industrial development in Newington, sandwiched between the industrial centers of Portsmouth and Dover, due to lack of sufficient waterpower and insufficient demand. However the local blacksmith trade

grew in response to the needs of the stagecoach lines and the local farmers (Strafford Rockingham Regional Council 1981).

Brickmaking was an early industry on Dover Point where deposits of natural marine clay, also known as blue clay, were found along the banks of the Piscataqua and its tributaries. Settlers made the earliest bricks for chimney construction (Scales 1923).

Residents of Dover Point worked as farmers, freighters on the river and as brick manufacturers. Early nineteenth century fires in Portsmouth and the 1822 construction of brick mills for the Dover Cotton Factory increased the need for bricks, heralded as a fireproof building material (Monroe 1998).

1820-1870: Brickmaking and Dairy Farming

Brickmaking was a dominant part of the local economy through the mid-nineteenth century. Beginning about 1830, Enoch Pinkham owned the Henderson brickyard at the southern end of Dover Point (Scales 1923:58).

At the same time, downtown Dover developed as an industrial center. In the early 1820s, Dover Cotton Factory, reorganized as the Dover Manufacturing Company, later known as the Cocheco Manufacturing Company, had several large cotton mills and, later, printing operations in downtown Dover in a mill quadrangle. The Sawyer Woolen Mills, the second largest textile manufacturer, also was established in this same period along the banks of the Bellamy River. The social character of Dover began to change along with the changes in the visual character of the town due to the manufacturing industries. There was an increase in the general population along with the introduction of new ethnic groups like the Irish, French Canadians and Greeks.

Industrial development in Newington was on a small-scale and could not compete with nearby Dover and Portsmouth with the exception of Cyrus Frink's brickyard, a small local operation on the banks of Little Bay.

As the brickyards of Dover Point flourished during this period, the farmers in Newington began to capitalize on their agricultural endeavors. Farmers earned a profit because of the town's proximity to Portsmouth's marketplace. Numerous additions to the town's building stock in the first half of the nineteenth century indicate this period to be a time of local growth and prosperity, in part the result of a major local expansion in dairy farming. Following regional trends, Newington's economic base shifted from semi-subsistence farming to a market economy. Newington emerged as a major supplier to the dairy market in Portsmouth (Strafford Rockingham Regional Council 1981).

In 1855, the Piscataqua Bridge was irreparably damaged by ice floes and the bridge taken down. Commerce was again dependent on ferry and gundalow traffic in the region. A direct route from Portsmouth to Concord was not replaced until the

construction of the Portsmouth-Dover Bridge over Little Bay in 1873 and the Scammel Bridge over the Bellamy River in 1935 (Monroe 1990).

1870-1910: Expansion of Brickyards and the Railroads, Orchard Products

The growth of the brick industry was facilitated by improved technology, particularly with the introduction of horsepower.

The Piscataqua region brickyards were at their height in the 1880s and 1890s. Captain Adams, a gundalow captain from Durham, recalled from memory forty-three brickyards operating during his youth. Bricks were transported to Portsmouth by gundalow, or to Boston or Portland by schooner. The Dover Navigation Company operated a brick fleet of six to eight schooners through the 1890s. Known as "brickers," the schooners averaged 23-32 trips a season (Beaudoin 1988:170).

By 1842, railroad lines had arrived in both Dover and Portsmouth, but no direct connection between the two cities was laid until 1873, when Portsmouth and Dover Railroad crossed the Piscataqua River between Bloody and Dover points. The railroad portion of the bridge was a steel Howe truss purchased from Chicago; the highway portion was of traditional pile and trestle construction (Chesley 1984). The bridge was leased by the Eastern Railroad and later sold to the Boston and Maine Railroad in 1900 (Monroe 1990). Currents and ice jamming damaged the bridge, including a serious failure during World War I, and a new highway bridge was built at the crossing in 1933, the General Sullivan Bridge. The railroad helped the brick industry, and a spur was built to the Pinkham yard (Hurd 1882). Passenger and freight depots were constructed on Dover Point and in Newington within the current study area. The Dover Point depot is no longer extant; however, part of one exists today as part of a barn on Patterson Lane in Newington. The old toll house and railroad station at Bloody Point is extant, at the site of the railroad's river crossing.

Agriculture in Newington continued to prosper during this period. Dairy products were the major marketable commodity. Butter made on the farm was the most convenient method to preserve, transport and market their products. After 1873, local farmers sold their milk in bulk and shipped it to creameries by rail (Strafford Rockingham Regional Council 1981).

The opportunity for farmers to reach national and international markets, provided by the service of the new railroad, demanded the cultivation of a non-perishable crop. Orchards soon became a part of almost all farm operations, large or small, and helped establish Newington as center for apple production (Strafford Rockingham Regional Council 1981). As a result, the DeRochemont family operated two cider mills in the northwest portion of town fed by Willow Brook. These buildings stand today in the northwest portion of town.

The brick making trade declined on the rest of the Point as well during the first decades of the twentieth century, due to the depletion of clay and the mechanization

of the industry. The last large brickyards operating on the Point in 1908 were the Seavey & Loughlin yard, on the west side of the railroad bridge, and John E. Pinkham's, a short distance north (Scales 1923:57). Work continued in yards further north on Dover Neck until the 1920s (Scales 1923:57).

1910-1950: Decline of Brickmaking, Popularity of Summer Cabins and Houses, Shattuck Shipyard and Industrialization of Newington's Waterfront

The 1910s and 1920s were transitional periods on Dover Point, as brickyards closed and a community of summer cabins grew up in their place. Many of Dover Point's summer residents lived year-round in downtown Dover, among them the Chapmans, Cullens and Parles. Clyde Whitehouse, a Dover optometrist, built a camp between Wentworth's property and Hilton Point in 1928. More cabins as well as summer camps, some later renovated into year-round homes, were built through the 1950s (Monroe 1999).

During this period Newington's economic base began to shift from agriculture to industry. The catalyst for this change was the arrival of the L.H. Shattuck Shipyard on Bloody Point during World War I. Between July 4, 1918 and August 14, 1919, fifteen 3,500-ton, wooden steamships were launched in Newington. Wages at the shipyard were high for the time; unskilled laborers started at three dollars a day. Businesses in nearby Dover and Portsmouth had difficulty retaining their employees. Without any prior experience laborers were hired and there was a sudden and overwhelming influx of people arriving to learn shipbuilding. Quickly, all kinds of housing went up in the area around the shipyard to accommodate its personnel, much of it temporary or shoddy (Monroe 1998).

Essential services sprouted up around the shipyard including a hotel, hospital, store, and two restaurants soon after it began operation. After 1918, the yard decreased production and gradually began closing. Operation had completely stopped by 1919. Shattuck was the last and largest yard to build wooden ships on the East Coast. It was sold and became the American Dye and Chemical Company, makers of coal tar dye. Although the shipyard was short-lived it paved the way for the development of a heavy industrial zone along the river (Bolster 2002:105).

The American Dye and Chemical Company built a new plant on the site, which consisted of six utilitarian brick buildings with saw-tooth roofs, three of which remain. The dye company depended heavily on the railroad for raw material and transport of finished goods, until it went out of business in the 1930s. The Atlantic Terminal Corporation, who converted the site to an oil storage terminal and refinery, acquired the site and buildings (Strafford Rockingham Regional Council 1981). Freighters carrying crude and bulk oils had access to the terminal by way of the Piscataqua. The site continues to operate as a bulk oil storage facility under the Sprague Corporation.

Among the increasing industrial development along Newington's riverfront, some small twentieth-century capes and cottages were built for seasonal use although most

of the vacation cottages and camps in Newington were built along the pristine shores of the Great Bay in the town's western half. Summer cottage development along the Piscataqua River in Newington was concentrated on Patterson Lane and at the end of Avery Lane.

The character of the area further changed in 1934, when the General Sullivan (which was designed by engineers, Fay, Spofford, and Thorndike of Boston) and Scammel bridges were built, and the railroad bridge and line were demolished. Automobile traffic increased and Dover Point Road was upgraded as part of a statewide effort to improve north-south transportation routes. Businesses catering to summer visitors traveling by car opened on the Point.

1950-Present: Pease Air Force Base, Highway Expansion, Commercial and Industrial Development

The increasingly industrialized nature and loss of agricultural land and practice in Newington occurred shortly after the end of World War II. Beginning in 1952 the US Air Force began acquiring land in both Newington and Portsmouth for the construction of a Strategic Air Command base in the Northeast United States, believed to be crucial to the Cold War effort at the time. Portsmouth Airport, which had been used by the military during World War II, was acquired along with other acreage in Portsmouth. Ultimately the largest portion of the base was located in Newington comprising nearly sixty percent of its land area. The base, which was renamed Pease Air Force Base in 1957 in honor of Harl Pease, Jr., a New Hampshire World War II veteran posthumously honored with a Medal of Honor for heroism, severed the town into three distinct parts. The southern portion of the town near the Portsmouth and Greenland borders was completely isolated from the town center because the network of roads running through the air base was closed to civilian traffic.

Construction of the base entailed the acquisition of historic farmsteads and other buildings in the vicinity. By 1953, thirty-four graves had been re-interred, fifty families dispossessed and thirty dwellings, most of which were large farm complexes, were sold, destroyed, and only a few relocated in Newington.

The residential section of the base was designed in 1955 along the southeast corner of the base, adjacent to the Spaulding Turnpike, which was under construction at the time.

During the construction of Pease Air Force Base, the state highway department undertook the expansion of NH Route 16 and US Route 4 in 1954, renaming the improved highway the Spaulding Turnpike. The turnpike is 33.2 miles long between Portsmouth and Milton, continuing north toward the White Mountains as NH Route 16. A series of exit ramps was constructed at the northern end of the turnpike near the crossing to Dover to provide access to downtown Newington and Woodbury Avenue, which parallels the turnpike to the east. These exits have been reconfigured since that time to help alleviate increasing traffic congestion. The north-south

highway isolates the rural and residential section of Newington from the commercial and industrial development in the town's eastern half.

The highway passed over the Little Bay/Piscataqua River into Dover via a new two-lane bridge paralleling the old General Sullivan bridge to the west.

The highway divided the Point in half and made transportation between the halves nearly impossible, a situation that continues to exist. The proximity of the highway created an ideal place for the construction of new streets of subdivisions for the emerging bedroom community. With automobile transportation and commuting to nearby cities made possible and easier by the highway, a number of new streets with homes on small lots were developed. Cote Drive and Center Drive, located between Dover Point Road and the Piscataqua River, east of the highway, were built in the 1950s and continued to develop throughout the second half of the twentieth century. Homestead Road, and Pineview and Pearson Drives are cul-de-sacs off the west side of Dover Point Road north of the Exit 6 interchange that were developed after the construction of the highway. Other additions to the Point during this period included the construction of several homes on small lots along Dover Point and Boston Harbor Road, and the construction of many homes and cottages off of Leighton Way.

Since the arrival of the highway both Newington and Dover have become bedroom communities, although Newington has taken on the character of a regional commercial and industrial market as well. Dover Point has retained its residential character despite the heavy traffic that travels its roads. Despite, and in part because of the highway in Newington, the corridor has developed into the third largest retail market in the state supported by the Fox Run Mall and other large retail chains. Commercial development surrounds the highway and the riverfront supports some of the state's largest industrial employers such as Tyco, Georgia-Pacific, Westinghouse, and Sprague.

At the end of the 1980s, Newington was faced with another potential change to its way of life. The US Department of Defense began examining its military installations and targeted several as no longer being necessary for carrying out their national security mission. Pease Air Force Base was one of five Air Force bases identified as non-essential and slated for closure by the early 1990s. As a result, the Pease Development Authority was created by the state to devise a plan to redevelop the former base. Ultimately, in 1991 the Pease International Tradeport opened as a commercial airport and industrial/business park and has become the home to many companies. The Great Bay National Wildlife Refuge was created in 1992 as part of the base redevelopment process (Pease Development Authority 1993).

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3.13.3 Archaeological Resources

To fulfill requirements of Section 106 of the National Historic Preservation Act and its accompanying regulations, a preliminary archeological reconnaissance level survey (Phase I-A) was conducted for the proposed study area. Research was completed between May and October 2003, and included background research, visual inspection of the study area, interpretation of data and preparation of this report. The purpose of this study was to identify known archeological resources and locations of archeological resource sensitivity within the study area which would constitute constraints to project design. This was accomplished through a strategy of research and field inspection addressing both terrestrial and underwater resources.

Definitions

Archaeological resources include cultural and culturally associated remains below the surface of the ground as well as ruins above it. The later resources may include standing buildings, structures, objects, and landscapes when these resources are examined primarily for the data they may contain and relate to associated archaeological deposits.

Native American archaeological resources are those locations and resources once occupied by Native American or Indian peoples. They both pre- and post-date the initial period of European settlement of the Americas, known as the contact period.

For the purposes of this project, historical archaeological resources are those sites and associated resources that usually date to and after the period of initial European contact with Native Americans. They not only include below ground resources and foundations or ruins, but also the culturally associated landscapes and standing buildings. The data associated with these sites includes not only the archaeological records but also the written, oral, and pictorial documents. While these resources are examined primarily for the data they may contain, associated standing resources may also gain significance for their architecture.

Methods

Background research and documentary review was conducted to identify previously recorded archeological resources and to complete a chronology of past human activity within the study area. This was intended to provide a research baseline for addressing sites, features or remains and their contexts. Data accumulated from archival sources were used to identify particular sites, features, or past land use patterns. Background research also permitted development of contexts to develop expectations for resource presence in the study area.

Research was completed using a variety of primary and secondary sources. Research was conducted at a number of institutions including Strawbery Banke Museum, the

Portsmouth and Newington libraries, the New Hampshire Historical Society, the NHDHR, the NHDOT, and the UNH. Data collected from these sources are documented throughout the text and in the References Cited section of this report.

Documents reviewed included the following: state-wide site inventory files maintained by the NHDHR; published and unpublished archeological site reports, including previously conducted cultural resources management studies in the project vicinity, filed with the Consultant or at the NHDHR; local and regional histories, available at the New Hampshire Historical Society, Strawbery Banke Museum, the Portsmouth Library and the Newington Library; historic and topographic maps, in files at the NHDHR, the Newington Library, Strawbery Banke Museum, and in secondary sources; historic photographs and aerial photographs, available at the Newington Library, Strawbery Banke Museum, the NHDOT, and in secondary sources. Research was completed in collaboration with other scientists at the UNH Jackson Marine Laboratory and the Center for Coastal and Oceanic Mapping who provided assistance in collecting underwater data. These sources provided information on known and potential cultural resources within the study area.

Research was augmented with interviews with property owners, NHDOT personnel, NHDHR personnel, Strawbery Banke Museum historians, archeologists and marine specialists. Individuals are listed in the Acknowledgements section of this report.

Field inspection involved several steps and components. Inspection was completed to assess resource presence and sensitivity in the field. This was accomplished for both terrestrial and underwater resources.

For terrestrial resources, the study area was viewed using a strategy combining drive-over and walk-over survey. All roadways within the study area were driven and notation made on general conditions. A selected number of areas were walked. These included accessible shorelines, public property (*e.g.*, Hilton Park and Bloody Point), undeveloped or wooded sectors of the study area and the margins of historic roadways. In addition, all previously recorded archeological sites within the study area were inspected by walkover survey in all accessible areas. No subsurface investigations of any type have been conducted to date.

During visual inspection notation was made on terrain, disturbance or intrusions. All previously recorded sites were inspected to confirm their existence, location and status. When new sites, features or resources were discovered, preliminary field sketches were made, photographs taken and information collected to compile a minimum-level site recording form. Sketches were drawn using compass and tape to record overall dimensions of visible features or remains. Observations on the likely occurrence of archeological resource presence were also made during visual inspection, based on such environmental qualities as visually intact landscape surfaces, topography, drainage and overall setting.

Field survey also involved walkover along cove margins for underwater resource assessment. This was undertaken at a low tide that had drained the coves. The occurrence of cultural features was recorded during this effort.

For nautical or underwater resources, several approaches were used. The search for locations of maritime archeological resources was initiated by a search through the Encyclopedia of American Shipwrecks (Berman 1973). To obtain a sense of the presence of any partially submerged features reflecting human activity, aerial photographs of the area were also reviewed. These primary sources did not indicate the presence of any shipwrecks or partially submerged features in the study area.

Field survey was then undertaken to recognize the presence of any nautical resources visible during a full moon low tide. This involved walkover along drained cove margins for nautical resource assessment. The occurrence of cultural features was recorded during this effort. Because of the severe current, no diving was conducted within the river channel.

Survey of deeper waters in the vicinity of the Little Bay Bridge was completed using data produced during underwater mapping efforts. A map was produced by remote sensing, using a 8125 Multi-beam Echo Sounder, a Marine Magnetics Gradiometer, and a NOAA Shallow Water Survey Set, and was made available by the Jackson Marine Laboratory and the Center for Coastal and Oceanic Mapping at the University of New Hampshire. This map provided an underwater topographic view of the study area. Other underwater data were produced by remote sensing systems that provided coverage of the submerged sector of the study area. This included completion of five video tracks using a custom-made Aqua-Vu black and white camera (Model IR) with a Sony digital video camera (Model DCR-TRV-103) with real time locations plotted along tracks. Video camera tracks were produced by towing this underwater camera system. Coverage of the study area was insured by interlacing the camera tracks. Coverage in waters shallower than 18 feet was limited due to potential camera damage. All underwater images were then assessed to define anomalies and determine the presence of any cultural occurrences within the river bed.

Archeological resources sensitivity rankings were assigned to all portions of the study area. The rankings were developed specifically for this project, based on the nature and quality of information available as well as discoveries made in the field. Rankings were uniformly applied to both pre-contact and proto-historic Native American and historic period Euro-American occurrences. Resource sensitivity was defined as: no sensitivity; probably sensitivity; sensitive for resource occurrence; and verified sites. No resource sensitivity for sites of any age was assigned to those areas which were positively confirmed as having no likelihood of resource preservation due to extensive disturbance and landscape modification. Probable sensitivity for sites of any age was assigned to those areas where a veneer of surface disturbance was believed to likely be covering areas which would otherwise be considered sensitive. Areas were assigned sensitivity for the occurrence of archeological

resources of any age on the basis of a variety of criteria including historic map data, topography, setting (*e.g.*, soils, drainage and proximity to surface water features), or analogy to other recorded sites in the locale. Actual sites, features or resources of any age or cultural affinity were also defined and included both known and previously recorded sites as well as newly discovered sites found during this survey.

Based on archival research and field surveys, areas within the study area were classified according to their archeological sensitivity as depicted in **Figure 3.13-2.** Additionally, detailed information on each of the areas mapped is included in Appendix E.

3.13.3.1 Native American Archaeological Context

The Piscataqua region has a rich and varied archaeological record that reflects over 11,000 years of occupation by Native American peoples. Sites with artifacts and components from all major time periods and cultures are present within the wider region. They are found in a variety of environmental settings that reflect the changing economic and adaptive strategies of Native people and changes in the local environment since the end of the Pleistocene. Habitation site locations are generally correlated with a number of specific environmental variables, notably including well-drained soils and proximity to fresh water, but artifacts reflecting more specialized activities (*e.g.,* hunting, gathering, or fishing) may be found in many settings in the Piscataqua region. The Native American archaeological record has become intermingled with that of Euro-Americans, and Native artifacts many thousands of years old occur in association with European sites of the 17th, 18th and 19th centuries. This requires archaeologists to address the archaeological records of both cultures even when undertaking research projects that are strictly "historic" or "prehistoric" in nature.

The Piscataqua region of New Hampshire and southern Maine was inhabited by Native Americans for 11,000 years before the arrival of the first European. This long and complex history is reflected today in the many Indian place-names of the seacoast region (Ogunquit, Kennebunkport, Piscataqua, *etc.*), by the ongoing presence of Native people, and in the work of archaeologists.

In the coastal areas of New England, European contact began shortly after 1500 AD with the arrival and written accounts of the first European explorers, traders, missionaries, and colonists. Within 150 years, diseases of European origin and the violent effects of colonialism had produced astounding mortality rates among Native populations (Snow 1980:32-35; Day 1978; Cook 1976). Few of the survivors would remain in the seacoast area, as refugee communities formed in other areas and "praying Indian" settlements were established by European missionaries. The severity of the disruption of Native life limits the extent to which historical

knowledge can be derived from oral histories, and places a greater burden on archaeology.

The archaeological record of the Piscataqua region is simultaneously rich and fragile, and beset by inherent limitations. Foremost among these is the acidic soil of New England, which ensures that most organic remains (wood, leather, textile, *etc.*) will quickly decay. Thus, the archaeological record is dominated by the less perishable items of everyday life, particularly stone tools and, after 3000 B.P., ceramics. Consequently, archaeologists are left with a partial and unrepresentative sample of what was undoubtedly a rich material culture. Some of the few exceptions to this rule are found on coastal sites, where shell middens neutralize the acidity and organic remains may be preserved. Examples of this are seen in the relatively rich bone tool assemblages from the Rock's Road and Hunt's Island sites in Seabrook (Robinson and Bolian 1987; Greenly 1998, 1999).

A second limitation on the early archaeological record comes from the extensive destruction brought about by the activities of the historic period. Plowing, road building, and the growth of cities and towns since the 17th century have disturbed or destroyed countless pre-contact sites, and has left archaeologists with, again, a partial and unrepresentative sample of what was the total range of site locations and types. This process has been particularly pronounced in urban areas, which often arose in the same locations most attractive to Native people. In coastal and estuarine settings, extensive filling of inlets and marshy areas introduced soils from other locations, and with this, artifacts removed from their primary context and redeposited sometimes miles from their original location. In such a situation, it is crucial to correlate artifacts with soil strata and to understand the nature and origin of each stratum.

The study area is situated in what would have been an attractive setting for Native Americans over time (Brummer and Chesley 1980; Harrington and Kenyon 1987). The abundant resources of the coast were only a few miles to the east. Estuaries, some of the most productive environments in northeastern North America (Thorbahn and Cox 1988), abounded. The Great Bay estuary, formed where the major tributaries of the Piscataqua River join before flowing to the ocean, is one of the largest estuarine systems on the Gulf of Maine (Potter *et al.* 1992:6). Here numerous species of shellfish, fish, and birds were to be found. Finally, the resources of the interior woodlands were also close at hand, including such staples as white-tail deer, nuts, and the abundant resources of fresh-water wetlands (McBride 1992).

This rich environment, however, developed over time. The formation of Great Bay and its associated drainages was significantly influenced by glacial activity at the end of the Pleistocene. The retreat of the glacial ice sheets at the end of the Pleistocene (c. 13,000-10,000 B.P.) resulted in "...an invasion of sea water which rose approximately 180-200 feet above the present sea level. During this period, low-lying areas and interior stream valleys as far inland as present-day Kingston, Lee, and Rochester were inundated. The extent of this invasion is delineated by deposits of marine clays and outwash deltas....As the ice continued to retreat and the coastline began to rise,

these features were exposed and reworked by wave action. The resulting complex pattern of surficial deposits includes remnants of kame terraces, outwash deltas, former beaches, and interbedded marine sand, silt, and clay" (Potter 1994:13).

Soils in this area were formed in the remains of glacial till, with coarse glacial till predominating in the uplands and glacio-fluvial deposits on the outwash plains and terraces (Potter 1994).

The position of the shoreline at the end of the last period of glaciation underwent a complex series of changes (see Hart 1994:12-33), where the period of initial marine transgression was followed by a period of rapid crustal rebound and corresponding regression, with sea levels being "tens of meters" lower than present during the early Holocene. Continuing glacial melting and a slowing of crustal rebound then raised sea levels to their present levels by several thousand years before present (Oldale 1986:90). Thus, prior to 10,000 years ago, miles of now-submerged shoreline were available for human occupation, but by 3,000 years ago this reach had become submerged. Today, we may discover coastal sites reflecting habitation between *ca.* 10,000 or 11,000 years ago to 3,000 years ago in submerged settings anywhere within the coastal zone.

For most of the pre-contact period, the Piscataqua region was an attractive one from the standpoint of Native American inhabitants. Easy proximity to three major environmental zones (interior forest, estuarine, and coastal) provided a wide variety of potential food and other resources.

The choice of specific site locations by Native people, however, was shaped considerably by a number of environmental variables. Slope, drainage, and proximity to fresh water have long been recognized as important factors in site location, with native people selecting level ground with well-drained soils near surface water features (Bunker 1994). In the vicinity of Great Bay, Native people recognized and discriminated among different soil types in choosing settlement locations:

In coastal areas, where soils of good and poor drainage are inter-fingered, sites are positioned on soils of better drainage even when poorly drained soils occur only a few meters away (Bunker 1994:25-26).

A review of site locations in the Great Bay/Piscataqua drainage indicated that 90% of known sites are located in areas of dry sandy outwash or till soils, either on stream banks to as much as 500 to 750 feet from water (Anonymous 1991). Native people were apparently selecting for small "islands" of dryer soils in proximity to stream rapids and tidal marshes (Potter et. al. 1992:8-9). The potential for archaeological sites within the Piscataqua region is tied to the area's geological history. Human habitation was not possible until the retreat of the glacial ice sheets approximately 13,500 years before present and the archaeological record for northeastern North

America conclusively dates the arrival of people some 2,000 years after this time (Gramly and Funk 1990).

The Paleoindian Period (11,500-10,000 B.P.)

This period marks the first human habitation of New England. Ethnographic analogies and archaeological evidence suggest these Paleoindian people, ancestral to later Native American populations, lived in small bands, practiced an economy in which hunting of large mammals was important, and were highly mobile. They entered New England from the south and west at the end of the Pleistocene period (Spiess and Wilson 1987:130), following by only a few thousand years the retreat of the glacial ice sheets. New England at this time was a challenging environment for human beings, as a major climatic transition created instability in the landscape and floral and faunal communities.

Large-bodied Pleistocene mammals, such as mammoths and mastadons, were rapidly dying off, while caribou and other modern species were increasing in number (Curran and Grimes 1989: 57-58). The common focus on large game and the presumed rapid spread of the Paleoindians across North America left a relatively homogeneous set of artifacts in the archaeological record of this time period. Foremost among these are variations of the fluted point, the most diagnostic artifact of the Paleoindians. Other artifacts include a variety of stone knives and scrapers, pieces esquilles or wedges, awls, drills, and hammerstones (Gramly and Funk 1990; Wilson and Spiess 1990). While no tools of organic material (bone, antler, wood, leather, *etc.*) have been recovered from New England Paleoindian sites, this is undoubtedly due to problems with preservation. Many of the stone tools from these sites were used in an extensive industry based on non-lithic technology.

Further evidence of the complexity of Paleoindian life comes from the stone often used in the manufacturing of tools. While local stone tool materials were used (Boisvert 1999; Bouras and Bock 1997), the Paleoindians of New England also relied on high quality cryptocrystalline stones such as chert or jasper, often obtained from great distances (Petersen 1995:212-213; Spiess and Wilson 1989). At the Bull Brook site in Ipswich, Massachusetts (25 miles south of the Piscataqua), so called "Pennsylvania" jasper (c.f. King *et al.* 1997), and cherts from Maine and the Champlain Valley dominated the lithic assemblage (Grimes 1979). While this pattern may reflect the high mobility of Paleoindian peoples, the extent of their social networks, or both, it is a signature pattern for sites of this time period.

Paleoindian site location is strongly correlated with particular environmental variables, most notably the presence of sandy, well-drained soils, particularly when adjacent to swampy areas (Bunker and Potter 1999; Spiess and Wilson 1987:130-131). Other environmental variables thought attractive to Paleoindians include prominent outlooks for observing the movements of game, and narrow valleys where herds of animals could be more easily hunted (Boisvert 1999; Bouras and Bock 1997; Gramly 1982). Because the Paleoindians were living in an environment markedly different

from later Native Americans, their choices about settlement were likewise quite different. As a result, Paleoindian sites tend to be "single component" sites, free of admixture from more recent occupations. This results in an archaeological clarity that permits the identification of discrete activity loci or living areas, and a greater potential for studying intra-site dynamics such as cooperative hunting and meat sharing (Gramly 1982).

Paleoindian sites have been located in the modern seaboard lowland area of northeastern Massachusetts and southern Maine, and illustrate the diversity and complexity of the Paleoindian archaeological record in this region.

In sum, there is clear archaeological evidence for the presence of Paleoindian sites in the Piscataqua region. Like contemporaneous sites in other parts of New England, these sites contain a variety of diagnostic stone tools, and the lithic raw materials reflect travel to, or connections with Paleoindian bands throughout the northeast. Paleoindian sites are found in specific geologic and topographic settings, and an understanding of site location and settlements for this dynamic period is dependant on adequate information on deglaciation, sea level rise, the formation of river drainages, and crustal rebound.

The Archaic Period (10,000-3,000 B.P.)

The Archaic period in the prehistory of eastern North America extends for some 7,000 years, beginning at approximately 10,000 B.P. The Archaic is conceived of as a time during which the broadly similar big-game hunting cultural systems of the Paleoindian peoples gave way to more regionally and locally distinct cultures, each shaped by the resources and conditions present in their domain. Increasing climatic and environmental stability, the development of river drainage systems and estuarine environments, and a growing familiarity with local environments and resources contributed to the emergence of regionally distinct cultures that were the precursors of the enormous cultural and linguistic diversity present among Native American peoples at the time of European contact.

A number of cultural trends characterize the Archaic period in New England. The theme of "settling in" to local environments is reflected in a general decrease in the quantity of exotic lithic materials, as people relied increasingly on lithic resources closer to home. A variety of ground-stone tools appear in the archaeological record, including axes, gouges, adzes, chisels, plummets, and net sinkers. Many of these are believed to have been used in woodworking, boat-building or fishing. The Paleoindian emphasis on the hunting of large-bodied, gregarious mammals gave way to a broader, more varied diet that included increasing amounts of plant foods, fish, and smaller-bodied birds, mammals, and reptiles. The first evidence of cultures specially adapted to coastal and marine environments dates to this period. Long-distance travel in pursuit of migratory herds gave way to patterns of seasonal movement within more restricted areas and the repeated occupation of favored sites. The consistency in settlement patterns also lead to the establishment of actual

cemeteries, where the dead were interred in increasingly complex ways and that continued to be used, in some cases, for centuries or even millenia.

The regional diversification typical of the Archaic period contributed to an increasingly heterogeneous archaeological record. Unlike the broad similarities in the artifacts of the Paleoindians, archaeologists recognize materially distinct "cultures" in the Archaic period of New England. In some instances, these different "cultures" correspond to distinct environmental zones, but in others they seem to cut across them. These cultural differences are reflected in the raw materials used for stone tool production, in the styles of the tools themselves, in the choice of site locations and the resources utilized, and in mortuary rituals. Throughout this period, people continued to live as hunter-gatherers, presumably in relatively small social groups or "bands". These bands, based on analogies to band societies studied by cultural anthropologists in the 20th century, are assumed to have been relatively egalitarian, lacking formal leaders or any formalized hierarchy or social divisions except those based on gender and age. Both the archaeological record and the work of cultural anthropologists suggest hunter-gatherer bands were stable, self-sufficient societies that provided adequately for the biological and social needs of their members and that existed in a sustainable relationship with the natural world.

The Early Archaic (10,000-8,000 B.P.)

The Early Archaic period in New England was initially thought to be a period of very low population or even a population hiatus, corresponding to what was believed to be the dominance of a low-resource boreal forest environment of the early Holocene (Ritchie 1980; Fitting 1968). Recent paleo-environmental reconstructions and archaeological research have shown both of these assumptions to be erroneous, and populations of the Early Archaic are now regarded to have been comparable in number to the more recent Archaic periods (Dincauze and Mulholland 1977; Robinson and Petersen 1992; Robinson 1992).

Prior to the recent research of Brian Robinson (1992), the best known Early Archaic manifestation in New England was characterized by distinctive projectile points with bifurcated bases, comparable to contemporaneous points found throughout much of the Atlantic seaboard region (Dincauze and Mulholland 1977; Snow 1980:160). The greatest concentration of these points has been recovered in southeastern New England, but rarely as part of larger components that would shed light on the overall nature of Early Archaic cultures. Other locally distinctive Early Archaic bifaces are known from northwestern Vermont (Thomas and Robinson 1980). At least one isolated find of a bifurcate base point has been reported from the Piscataqua region, from Shaw's Hill in the Exeter River drainage (Potter, *et al.* 1992:9).

The understanding of the Early Archaic period in New Hampshire and the Gulf of Maine has been transformed by recent research (Bunker 1992; Robinson 1992; Robinson and Petersen 1992). Drawing on data from sites ranging from the mouth of the Merrimack River to central Maine, Robinson defined a Gulf of Maine Archaic

Tradition that spanned a 4,000-year period from 10,000 to 6,000 B.P. Situated in an environment that Robinson depicted as rich and well-watered, the peoples of this tradition made extensive use of freshwater fish, produced a wide variety of beautifully made ground-stone tools, and, unlike later Archaic cultures, produced a flaked stone tool assemblage that included cores, flakes, and unifaces but lacked diagnostic bifacial projectile points.

Associated with this tradition was the Morill Point mortuary complex, named after a site at the mouth of the Merrimack River. This complex included cremation and non-cremation burials and the inclusion of red ocher, full-channeled gouges, ground-stone rods, and occasional non-diagnostic bifaces (Robinson 1992:94).

The Gulf of Maine Archaic tradition is arguably the best defined Early Archaic tradition in the Piscataqua region, although relatively few sites are known. In the Great Bay drainage, a Gulf of Maine Archaic component was identified at the Wadleigh Falls site on the Lamprey River in Lee, New Hampshire, radiocarbon-dated to 8630+/-150 years before present (Maymon and Bolian 1992:123). In sum, the Early Archaic period in the Piscataqua/Great Bay drainage is most likely represented by artifacts attributable to the Gulf of Maine Archaic tradition, although bifurcate base points may be found here as well.

The Middle Archaic Period (8,000-5,000 B.P.)

The Middle Archaic period is well represented in the archaeological record of the Piscataqua region, mirroring its high visibility across much of New England. In the northern Gulf of Maine region, the Gulf of Maine Archaic continues through much of this period, and is believed to be ancestral to the later Maritime Archaic tradition distributed along the coastal areas from central Maine to the Canadian Maritimes. To the south and west in New England, a series of distinct archaeological complexes is recognized. First defined at the Neville site in Manchester, NH (Dincauze 1976), they include the Neville Complex (c. 7500 B.P.), Stark Complex (c. 7000 B.P.), and Merrimack Complex (c. 6500 B.P.) the first two of which have related analogs along the Atlantic seaboard as far south as Florida (Dincauze 1976:140-142). Neville and Stark complex sites have often been associated with inland riverine fishing stations, with anadromous fish being a critical economic resource although one recent study has questioned this interpretation (Carlson 1988). During this period the first evidence of shell fishing appears in coastal areas, and nuts become an increasingly important resource in interior forests.

At the mouth of the Merrimack River, the Morrill Point Mound site was used by Robinson (1992) to define the Morril Point Mortuary Complex, the mortuary component of the Gulf of Maine Archaic. At this site, cremation burials including red ocher, gouges, adzes, celts, stone rods, radiocarbon dated between 6325 and 7245 B.P. The presence of this site to the south of the Piscataqua region, and the presence of related sites to the north in Maine (Robinson 1992:79-86) indicate that people of this

tradition were also present along the New Hampshire seacoast during the Middle Archaic Period.

At the same time, sites with Neville and Stark complex components are well-documented in the Piscataqua region, although the relationship between these sites and those of the Gulf of Maine Archaic is not clear. At the Wadleigh Falls site in Lee, NH a well-defined Neville complex component was recognized in a stratigraphic layer overlying a Gulf of Maine Archaic component, an associated faunal assemblage dominated by reptiles (snake and turtles) but also including shad, deer, beaver, and muskrat. (Maymon and Bolian 1992: 122-131). Elsewhere in the Piscataqua region, numerous Middle Archaic bifaces have been recovered at the Hayden Farm site in Newfields (White and Finch 1959, 1975: Plate 3). Middle Archaic bifaces were recovered from the Alexander site on the Exeter River in Raymond (Finch 1962), a Stark/Neville drill was found at the White Site on the Exeter River (Potter, *et al.* 1992:9), and a Merrimack-like point was recovered during excavations at the Deer Street site (DS 2.8B) by archaeologists from the Strawbery Banke Museum.

In sum, Middle Archaic sites associated with either the Gulf of Maine Archaic or the Neville, Stark, and Merrimack complexes may be expected in the Piscataqua region.

The Late Archaic Period (5,000-3,000 B.P.)

The Late Archaic period is one of the most complex and dynamic in the prehistory of northeastern North America. Temporal and spatial variability in the archaeological record has suggested to some archaeologists the existence of as many as four distinct archaeological traditions in New England, the overlapping settlement of peoples "belonging" to these traditions, and the possibility of a major episode of migration at the end of this period. One of the four traditions, the Maritime Archaic, is generally located well north of the Piscataqua region, and will not be considered here. Artifacts from the remaining three traditions, the Laurentian, Small Stem, and Susquehanna are all encountered at sites in the Piscataqua region.

The Laurentian tradition is the oldest of the Late Archaic traditions, beginning as early as 6000 B.P. and continuing to 4000 B.P. (Ritchie 1980:79; Funk 1988; Snow 1980:216-222). When first defined by William Ritchie, it was described as an interior, lake-forest cultural tradition extending from northern New England and New York to southern Quebec and Ontario. In much of New England, however, the Laurentian is recognized in a scattering of diagnostic projectile points, with very few intact components, so that its true nature remains unknown (Dincauze 1975; c.f. Funk 1988). The lack of fit between the original definition of the Laurentian "culture" and the distribution of diagnostic Laurentian artifacts is clearly seen in the Piscataqua region. While true Laurentian components would not be expected in a coastal/estuarine environment, Laurentian points have been recovered from the Hunt's Island and Rock's Road sites in Seabrook (Greenly 1998:Plate 3; Robinson and Bolian 1987:38), the Hayden's Farm site in Newfields (White and Finch 1975:Plate 4), on Pettee Brook in Durham (Goodby 1998:5), and the Nelson Island site in

northeastern Massachusetts (Robinson 1985:11-12). At none of these sites, however, are there defined Laurentian components--merely low numbers of points not clearly associated with other cultural material.

The Small Stem Tradition is well-represented in the archaeological record of the New Hampshire seacoast region, as it is elsewhere in New England. A series of narrow stemmed, and triangular projectile points, most often manufactured from quartz, are the most widely recognized diagnostic artifacts of this tradition, and actually continue in use through much of the following Early Woodland period (*e.g.*, Goodby 1996:10-11). Small Stem sites are found in a variety of environments, including coastal, estuarine, and interior riverine settings, indicating a great deal of economic diversity within this tradition. Small Stem components have been found in the Cocheco River drainage (Dubois n.d.), at the Hunt's Island and Seabrook Marsh sites in Seabrook, NH (Greenly 1998; Robinson 1985) and the Hayden Farm site in Newfields (White and Finch 1975: Plate 2; Skinas 1980). Small Stem points have also been recovered from the Rock's Road site in Seabrook (Robinson and Bolian 1987: 38-39) , at two sites in Maine on the Salmon Falls River (Bunker, *et al.* 1990), at the Newmarket Town Farm site (Skinas 1980:3), and in the excavation of site SB20.157 at Strawbery Banke.

Important data on the Small Stem Tradition came from the Seabrook Marsh site, where evidence for a specialized marine-oriented economy was recovered (Robinson 1985). The remains of swordfish and other deep-water marine species provided indirect evidence of considerable skill in boat-building and fishing, and the existence of a well-developed maritime culture generally. Other faunal remains were from estuarine and terrestrial species, including a variety of birds and mammals. Finally, human burials from the site provided a glimpse into the developed and complex spiritual lives of this society. The Seabrook Marsh site provided convincing evidence that a marine focus was not limited to the Maritime Archaic, but could be found among other Late Archaic cultures further south along the New England coast.

The Susquehanna Tradition represents the most recent, or "terminal" tradition of the Late Archaic period. Its diagnostic attributes include a variety of broad-bladed bifaces, carved steatite bowls, and cremation sites, where burned human remains were deposited with ritually broken or "killed" artifacts (Dincauze 1968, 1975; Snow 1980:235-259). The artifact styles and burial practices of the Susquehanna tradition were so distinct from earlier cultures in New England that many archaeologists have argued for a migration of Susquehanna populations into New England from the southwest shortly after 4000 B.P. (Dincauze 1972; Ritchie 1980; Borque 1995:245-247). In New England, the Susquehanna Tradition lasts for a maximum of 800 years before giving way to the cultures of the early Woodland period. Susquehanna period sites are found from southern Connecticut north to the central Maine coast (Borque 1995:7-10), and the tradition itself is divided into a number of distinct phases marked primarily by changes in projectile point morphology (Dincauze 1968, 1972, 1975).

In the Piscataqua region, Susquehanna Tradition materials have been recovered from a number of sites, including the Rock's Road site, where an intact Atlantic Phase component was identified (Robinson and Bolian 1987: 38), at the Hayden Farm site in Newfields (White and Finch 1975), at the Seabrook Marsh site (Robinson 1985:42), and the Stanley site in Exeter (Foster 1982: 41).

In sum, sites attributable to three Late Archaic traditions are expected to occur in the Piscataqua region. These sites may occur in a variety of environmental zones, and include habitation sites, specialized food procurement sites, or cemeteries.

The Woodland Period

In eastern North America, the Woodland period of prehistory begins at approximately 3000 years before present. The Woodland period by definition is characterized by major cultural changes that take place over a broad area and an increase in cultural and societal complexity. The first of these changes is the advent of farming, or horticulture, notably of the Mesoamerican cultigens maize (corn), beans, and squash. The second major change during the Woodland period, clearly linked to the first, is an increase in sedentary settlements and the beginnings of village life. A third change is the appearance and spread of a number of mortuary "cults" or traditions, notably those of the Adena, Hopewell, and Mississippian moundbuilder cultures. Finally, there are substantial changes in material culture, the most notable of which is the advent of ceramics. Woodland societies are generally believed to have been larger, more densely populated, and more prone to hierarchical social structures than the generally egalitarian societies of the Archaic period.

The Woodland concept as defined above, however, does not accurately describe the situation for New England. There is considerable continuity between the Archaic and Early Woodland periods in material culture, settlement patterns, economy, and mortuary ritual (Heckenberger, *et al.* 1990; Filios 1989). There is little evidence for an increase in sedentarism at the onset of this period. Evidence for agriculture in the form of carbonized remains of cultigens is almost entirely limited to the period after 1200 B.P., indicating that cultivation began in New England considerably later than in other parts of eastern North America, and even when cultivation does begin it appears to have been as a supplement to the traditional broad-based hunter-gatherer economy. Actual village sites dating to the Late Woodland have proven notoriously elusive to archaeologists (*e.g.,* Kerber 1988; Leudtke 1988). In fact, the only real change in New England at 3000 B.P. that is in keeping with the Woodland concept is the appearance of pottery.

The Early Woodland Period (3,000-2,000 B.P.)

The Early Woodland period in New England is marked by the appearance of some new projectile point styles (notably the Meadowood and Rossville point types), pendants, gorgets and "birdstones" made of ground slate, copper beads, tubular blocked-end stone pipes for the smoking of tobacco, and widely scattered cemeteries,

where complex burials are laden with exotic artifacts and raw materials from across much of eastern North America (*e.g.,* Heckenberger, *et al.* 1990). One of the most distinctive and commonly encountered artifacts of the Early Woodland is the Vinette I ceramic vessel, which are typically undecorated conical pots made with thick coils of clay tempered with large pieces of crushed quartz or feldspar. Both the exterior and interior surfaces of these vessels bear the impressions of the fabric-covered paddles used to paddle the vessel walls and bond the coils together. Vinette I vessels appear in New England as early as anywhere else in the northeast, with some of the earliest dated examples coming from the central Merrimack River valley of New Hampshire (Bunker 2002, 1992:138; Howe 1988).

In the New Hampshire seacoast region, Early Woodland components including Vinette I ceramics and Meadowood points are present at the Rock's Road and Hunt's Island sites in Seabrook (Robinson and Bolian 1987:39; Goodby 1995:47-48; Greenly 1998:62). The component at Rock's Road also included a Rossville point, a large pit feature containing Vinette I ceramics radio-carbon dated to 2130+/-115 B.P., and a lithic workshop where "well-thinned bifaces reminiscent of Meadowood cache blades" (Robinson and Bolian 1987:39) were manufactured from blue-grey felsite. Early Woodland components are also present along Great Bay. A single Meadowood point was recovered at the Hayden Farm site (White and Finch 1975: Plate 4n), an interior/exterior fabric impressed ceramic sherd was recovered from the Great Bay site at Brackett's Point in Greenland (Finch 1969: Plate 6, 15), and Meadowood and Rossville points and Vinette I ceramics were recovered from the Stanley site in Exeter (Foster 1982:41; Finch 1967:Plate 2). Additionally, at least some of the sites where Small Stem tradition bifaces have been recovered may be of Early Woodland age.

The Middle Woodland Period (2,000-1,150 B.P.)

The Middle Woodland is one of the most visible periods for the Piscataqua region. The period is often subdivided into "early" and "late" stages, with pseudo-scallop shell impressed ceramics and Fox Creek points being key diagnostics of the former, and dentate-stamped ceramics and Jack's Reef pentagonal and corner-notched points of the latter.

While the archaeological record for the Middle Woodland period in New England shows little indication of direct influence from the midwestern mound-builder cultures, this is also a time of considerable dynamism in New England, seen most notably in evidence for long distance interaction in the form of exotic lithic materials. In the Piscataqua region, this takes the form of an exotic yellow-brown jasper that appears on sites dating to the late Middle Woodland (Barber 1982; Goodby 1988; Leudtke 1987; Strauss 1992). Often referred to as "Pennsylvania" jasper because of its presumed origin in a series of quarries in southeastern Pennsylvania (Leudtke 1987), recent studies have called this into question (Hatch 1993; King, *et al.* 1997). Regardless, it is clearly exotic to the Piscataqua region (Goodby 1988), and reflects the existence of long distance interaction between the Native peoples of the northeast during this period. Jasper was used in the manufacture of many different tools,

including Jack's Reef corner-notched points, unifacial scrapers, perforators, knives, and wedges for the splitting of bone, wood, or antler (Goodby 1988).

Important Middle Woodland sites in the Piscataqua region include the Rock's Road and Hunt's Island sites in Seabrook. At Rock's Road, an early Middle Woodland component is represented by pseudo-scallop shell impressed ceramics (Goodby 1995:48-49) and a single Fox Creek point, while a substantial late Middle Woodland occupation left behind dozens of jasper tools, thousands of jasper flakes, numerous features, and the remains of at least 14 ceramic vessels (Robinson and Bolian 1987; Goodby 1988, 1995). At nearby Hunt's Island , a comparable though less intensive Middle Woodland occupational sequence was present (Greenly 1998:62). In the interior of Great Bay, sites on Adam's Point in Durham yielded early Middle Woodland pseudo-scallop shell impressed ceramic sherds, and jasper Jack's Reef points, debitage, a shattered core and dentate-stamped ceramics from the late Middle Woodland (Hecker 1995). Other Middle Woodland components are present at the mouth of the Merrimack River (Barber 1982; Bullen 1949), in the interior Lamprey River drainage (Goodby and Ritchie 1989), and at the Great Bay site on Brackett's Point in Greenland (Finch 1962).

The transition between the Middle and Late Woodland periods at about 1100 B.P. is a time of considerable change in New England. Corner-notched projectile points disappeared and were replaced by triangular Levanna points. Dentate stamped ceramics were replaced by cord-wrapped stick impressed and other ceramic decorative types (Petersen and Sanger 1991). Most dramatically, exotic lithics all but disappear from the archaeological record, to be replaced by locally or regionally available lithics reflecting what appears to be a rather sudden end to the intensive exchange or interaction of the Middle Woodland. Finally, Native societies begin to cultivate maize and other exotic domesticates. The relationship among these events has not yet been clearly explained by archaeologists.

The Late Woodland Period (1,150-450 B.P.)

The Late Woodland period in much of New England is characterized by the incremental addition of horticulture to local economies, a continuation of many traditional hunting, gathering and fishing patterns, the manufacture of increasingly sophisticated and elaborately decorated ceramics, and a reliance on locally available lithic materials. Triangular Levanna projectile points are a common diagnostic artifact. Ceramics undergo considerable change during the Late Woodland period, beginning with so-called "cord-wrapped stick" impressed ceramics that, by 500 B.P., are being replaced by finely made vessels decorated with ornate zones of incising and punctuation. Shell temper replaces grit temper in many ceramic vessels from coastal areas. Vessel form changes as well, with conical or ovoid vessel forms being replaced by vessels with constricted necks and clearly defined collars with castellated peaks, elaborate incised decoration, and occasional appliqued effigy figures (Petersen and Sanger 1991; Goodby 1994).

The Late Woodland period is rather poorly represented in the Piscataqua region, possibly in part because these relatively recent sites have undergone more historic disturbance than more deeply buried older sites. There are no sites that have revealed direct evidence of horticulture, although this is likely due to the small number of intact components excavated to date. A Late Woodland component was present at the Rock's Road site in Seabrook, but was apparently of lesser intensity or shorter duration than the preceding Middle Woodland occupation, based on the number of diagnostic bifaces and ceramic vessels recovered (Robinson and Bolian 1987: 40-41; Goodby 1995:53-54). Levanna points and shell-tempered ceramics marked a Late Woodland occupation at Hunt's Island (Greenly 1998), and a single Levanna point was recovered from the Adam's Point site on Great Bay in Durham (Hecker 1995:70). Incised ceramics from the Great Bay site in Greenland (Finch 1969:Plates 3-6) may date to the Late Woodland, as may two bifaces from the Hayden Farm site in Newfields (White and Finch 1975:Plate 4, a and e). A single sherd of incised ceramic was recovered in association with historic architectural debris by archaeologists from the Strawbery Banke Museum during excavations at the historic Warner House in Portsmouth.

The Contact and Proto-Historic Periods (450-300 B.P.)

The beginnings of European contact in northeastern North America are shrouded in mystery, although it is known to have begun in the early decades of the 16th century with the voyages of Basque and Breton fishermen to the rich fishing grounds off the northern New England coast (Brasser 1978). Little information was recorded by these fishermen about their contact with Native people, and nothing specific is known about early contacts in the Piscataqua region, although they are likely to have occurred given that the Isle of Shoals was an early European fishing site (Robinson and Bolian 1987:46). Possible early 17th century contact may have occurred in connections with the 1604 voyages of Samuel Champlain and the English captain George Weymouth, the latter of whom kidnapped a number of Indians from the coast of Maine (Brasser 1978).

By the time of the earliest recorded European settlements in the Piscataqua region in 1623 at Odiorne's Point in Rye and Dover Point in Dover, Native societies had already been transformed by the effects of European contact. Two English fish merchants, Edward and William Hilton, settled at Dover Point (first called Hilton's Point) in 1623, traded with local Indians, and are credited with the first Euro-American settlement in what would become Dover. Their activities were focused on the drying of fish for shipment to England, but by 1631 only three houses had been built here, and subsequent settlement focused on areas to the west around Cocheco Falls (Colby 1975). Members of the aristocratic "Fishmonger's Guild" which dominated the fishing industry from Newfoundland to New England, established fishing stations for the drying of cod and other fish at Dover Point. They used the same traditional European technology employed at Isle of Shoals and other locations in the region (Rowe 1987; Scales 1923; Thompson 1965; Wadleigh 1913). Further, the 1634 map of William Wood suggests considerable contact with and knowledge of the

Native population as indicated by the depiction of many village locations throughout coastal and interior locations as well as important place names.

European trade goods had been circulating among Native people before the settlement at Dover Point, bringing about changes in traditional technology and lifeways. A devastating epidemic in the years 1616-1619 produced rates of mortality estimated at 90% or more among many Native communities, particularly those on the coast (Snow 1980:38-40; Cook 1976). Survivors of the epidemic sought refuge in neighboring communities or coalesced to form new communities, at the same time that intensifying trade with Europeans and trade-induced warfare among Native peoples contributed to additional disruption of traditional culture and dislocation of traditional communities. One result was that the "tribal" groups and names recorded by Europeans during the 17th century are drawn from a rapidly changing cultural situation and are not reliable indicators of pre-contact social organization.

Who were the Native people of the Piscataqua region? Anthropologists and ethnohistorians have offered many answers to this question, and have incorporated the people of the Piscataqua into one or another larger cultural grouping, including the Massachusetts (Snow 1980:26), Pawtucket, and Pennacook (Stewart-Smith 1984:70). If the Piscataqua people were indeed Pennacook, they would likely speak a dialect of Western Abenaki as opposed to Massachusetts (c.f. Day 1978:148). Three "tribal" territories are said to have existed in the Piscataqua region: the Newichewannock, in the upper Piscataqua drainage; the Piscataqua, on the east bank of the Piscataqua River (Stewart-Smith 1994:71), and the Winnacunnet, in the Hampton/Seabrook area (Stewart-Smith 1994:71; Robinson and Bolian 1987:41). Following the epidemic of 1616-1619, many of the surviving members of these groups gathered at Dover, where they were known as the Cocheco Indians (Colby 1975:70). A smallpox epidemic in 1633 killed many of the remaining Native people in this area (Robinson and Bolian 1987:33).

The archaeological record of this period shows the rapid acculturation of Native populations in the face of disease and European encroachment, but also shows ongoing resistance to the process of acculturation. Archaeological sites from this period contain a wide variety of European trade goods, including iron axes and knives, brass and copper kettles, glass beads, metal buttons, and kaolin pipes. Native ceramics from this period are made with a high degree of decorative elaboration and technological sophistication that intensifies during the early decades of European contact (Goodby 1994). Artifacts from contact period sites clearly show that European goods were incorporated into Native cultural contexts; brass and copper kettles, for instance, were routinely cut into triangular arrow points that were clear copies of the stone triangular Levanna points being used on the eve of contact (Foster *et al.* 1981; Robinson and Bolian 1987:42).

In support of the above statement, contact period components are present at two sites in Seabrook, Hunt's Island and Rock's Road in the Piscataquog region. At Hunt's Island, a wampum bead and early kaolin pipe were recovered (Robinson and Bolian

1987:46; Greenly 1998:19). At the Rock's Road site, a large contact period component associated with the Winnacunnet people and dated between 1600 and 1630 included numerous shell-filled pit features, a large assemblage of bone tools (including some manufactured with iron tools), iron axes, iron knife handles, copper or brass triangular points, a tooth from a bone or ivory trade comb, and a deer effigy made of European sheet lead. (Robinson and Bolian 1987:43-45). Incised, collared and castellated ceramic vessels were also included in the contact period assemblage (Goodby 1995:54-56). Finally, three historic Indian trails, the Abenaki, Squamscott, and Piscataqua trails, converged in the Piscataqua region (Price 1967).

Native American Site Summary and Expectations

Evidence for thousands of years of Native American occupation is preserved in archeological sites which are fragile and easily erased by erosion, naturally acidic soils, submergence and destruction through the activities of historic and modern times. Yet, sites are known to have survived throughout the region, with examples known from the coastline, the margins of local streams and rivers, the urban landscape of downtown Portsmouth and the Pease Air Force Base property (NH DHR site files). While over 100 sites have been previously recorded for the Piscataqua and Great Bay environment, only a handful are known in and near the study area. In Dover, no Native American sites have been recorded within the study area, although the NH Division of Historical Resources site files assign sensitivity to Hilton Point, based on archival evidence. In Newington, sites have been recorded on Fox Point, Welsh Cove and Peverly Brook. Another site, Site 27-RK-302, was recognized by the presence of a biface of the Squibnocket Triangle type, dateable to *ca.* 4000 years before present. This was found in close proximity to the study area, on the western side of Knight Brook south of Broad Cove (NH DHR site files).Yet only one Native American site has been previously recorded in the study area in Newington. This is site 27-RK-275. It was recognized by the presence of quartz flaking debris at a terrace location on the east side of Pickering Brook. However, Phase II survey determined that this site lacked qualities for eligibility to the National Register of Historic Places (Hartgen Archeological Associates 1991).

On the basis of information collected from past archeological surveys and previously recorded sites, we may expect to discover Native American sites of all periods within the study area. Locations of particular sensitivity for these sites include shoreline margins, terraces along streams, the margins of springs and wetlands, and the upper banks of all major rivers, including the Piscataqua River itself. Sites are expected to occur on well drained soils, in fairly level terrain, and usually in close proximity to surface water features. Sites are not expected in areas which have been disturbed by repeated or extensive development and modern land use. Yet, sites may be found in areas where historic period activities, such as tree clearing, plowing and farming have modified only the upper portion of the soil column. Sites may contain components dateable to the entire cultural continuum, from early post glacial times

to the period of contact with Europeans. Sites are expected to include an array of cultural materials and features such as stone tools, pottery, trade goods, hearths or pits. In locations where shell is present, soil acidity may be neutral enough to preserve such fragile remains as bone refuse or tools (*e.g.,* food remain, bone points, needles, awls, combs, knives), and other perishable objects (*e.g.,* plant materials, basketry, worked wood).

3.13.3.2 Historic Archaeological Context

Historic Landscape

Two peninsulas – Dover Point to the north, and Bloody Point to the south - face one another across the mouth of Little Bay, and comprise the landscape of the study area. These points of land were among the first places visited and used by Europeans in North America and have witnessed a sequence of continuous occupation in an area defined both by land and by water. The landscape here has shaped settlement from the early 1600s into more recent times and, in turn, man's activity has reshaped the original landscape.

Dover Point, found in the southern sector of the present-day city of Dover, is a long spine, defined by terrain that rises gently from shorelines to an elevation slightly over 100 feet above sea level. The northern portion of Newington has a rolling quality, with a height of land also reaching an elevation of 100 feet above sea level. The segments of each town contained within the study area are defined by the waters which surround them. To the east lies the Piscataqua River, a "wily" river of powerful currents and unpredictable nature (Bolster 2002). To the west are found both Little Bay and Great Bay, filled with waters from half a dozen rivers that drain the coastal lowlands of New Hampshire. Within this landscape, a mosaic of resources were available to people; over time, people used and shaped the land, the water and the natural resources for permanent settlement, commerce and industry.

In the 1600s, Europeans arriving here saw a wild and forested landscape, rich in resources. Fish provided the first attraction, but, as settlements were established, timber was cut, fields were cleared and agriculture began. Vast acreage of forested land is recorded throughout historic times in both Newington and Dover. Maps show that a 5000 acre forest persisted in Newington into the 1800s and stands of oak and pine figured prominently in the history of Dover as shown on a historical map of the 1900s. The importance of timber is further evident in the creation of the Newington Town Forest, which was set aside as common ground in 1710 and is listed today on the National Register of Historic Places (NHDHR Town Files). Elements of the original setting permeated the locale until the most recent times. Even in the twentieth century people recall the area as an "unlikely place" with "miles of tidal shores, fragrant pines" "ponds, brooks, and grassy pasturelands where the berry bushes grew, the salt air of the river, and the changing tides of the Piscataqua" (Bolster 2002:104).

Water nearly surrounds Newington and Dover Point and is a prominent factor in the history of these communities. The rivers and bays were alternately viewed as resource zones, barriers and corridors. Abundant fish and shellfish have been recorded here during the past, and were the first economic magnet for historic period exploration and settlement. Lobsters, oysters, alewives, eels and smelt contributed to the fishing industry (Adams 1976); as recently as 1888, immense schools of fish were seen here "hundreds at a time" "leaping out of the river" "some … over a foot in length .. chasing the little minnows" (Adams 1976:140). While the rivers and tidal flats of Great Bay provided abundant fish and foods, people also needed to travel from side to side. Ferries and boats were integral to life here, not only for fishing but also for crossing the rivers and transporting people and goods between Portsmouth and interior villages. Special boats were developed for specific purposes, particularly the gundalow, unique to the Piscataqua, for its design and capabilities. The deep water of the Piscataqua was excellent for larger ships and by the time of World War I, shipbuilding became an important industry in Newington with the Shattuck Shipyard (Adams 1976; Bolster 2002; Switzer 1998). With time, man also modified the shoreline, removing obstacles to navigation and building ferry landings, piers and abutments for bridges. The first bridge across the river connected Fox Point to Durham, and was linked with a road extending to Portsmouth. Later, bridges connected Bloody Point in Newington to Hilton Point in Dover.

On land, resources directed industry. Forests provided lumber and masts for the first Euro-Americans. White pine was cut and transported to Portsmouth, then shipped to England (Rowe 1987:27-28). Later, wood was used for production of household and commercial goods on small scale. Notably, there was no water power, either along freshwater or tidal stream, for the development of mills here. In lieu of mills, another resource permitted industry to grow – this was clay. Extensive deposits of marine clay are located along the entire shoreline of Dover Point. These were mined during the nineteenth century for brickmaking; the brick yards of Dover Point produced millions of bricks and supplied the Portsmouth building industry.

Agriculture provided a strong economy here, in addition to fishing, timbering, brickmaking and other commerce. The landscape was well suited to farming, with its fertile soils. Fine sandy loams formed in glacial tills are found along low hills while loams formed in marine material are found elsewhere. These soil types are well suited to support woodlands, crops and forage, necessary for a mixed agricultural economy (USDA 1994). Family farms produced grain, potatoes and other foods. Apple orchards, dairy farms and poultry farms persisted into the twentieth century (Bolster 2002).

The landscape continued to be attractive for other purposes in the twentieth century. Large scale shipping and industry entered the Piscataqua River and the United States government developed a military installation on more than 4000 acres in Newington in the 1950s. The installation "cut the town in two" and in subsequent years growth of commercial and industrial zones has further segregated Newington (Bolster

2002:105-106). At Dover Point, lands were developed for public recreation with creation of Hilton Park, providing a beautiful vantage as well as river access. Throughout the study area, twentieth century development is visible. This includes the highway corridor itself as well as residential neighborhoods and numerous businesses and industries. Only remnants of the agricultural communities of the eighteenth and nineteenth centuries are visible and evidence of early settlement is preserved either in a few remaining standing structures or as archeological features.

Historic Chronology

The histories of Dover and Newington are intricately linked by a number of themes. Both communities also share a long time line, with recorded events spanning some 400 years.

One of the earliest European settlements in the New World was located at Dover Point. This was the Hilton plantation, marked by the arrival of Edward Hilton, William Hilton and Thomas Roberts in 1623. The Hiltons arrived from England to establish a cod fishing enterprise at Hilton Point. The fishery was based on a well-established international economy, within a network of coastal and land-based fisheries, including Panaway Plantation and the Isles of Shoals. The accompanying settlement was initiated as a private commercial enterprise (Harrington 1985; Hurd 1882; Rowe 1987; Scales 1923; Thompson 1965; Wadleigh 1913).

Soon, Edward Hilton was granted the Squamscot patent by the Plymouth Council from King James for extensive land holdings, including sections of present-day Dover and Newington. This was related to numerous land grants made between 1622 and 1635 in the Piscataqua and Merrimack River territories. By the early 1630s, Captain John Mason of the Council for New England, sent personnel and supplies to Hilton Point and in 1633, more people arrived from Salem, land was cleared, a meeting house established and dwellings built (Scales 1923:124). By 1640, English settlers were well established on both sides of the Piscataqua River, in a section known as the "Long Reach."

At this time, friction developed from disputes over control of the land, economy and the joining of communities to the north with Portsmouth. In 1641, Bloody Point was part of Massachusetts, but given to Strawbery Banke in 1642. Captain Neal of Strawbery Banke (Portsmouth) and Captain Wiggin of Hilton Point drew swords to settle the debate, and Bloody Point was the name given to what is now Newington. After the dispute, the land was presented to Dover in 1644 (www. nhcentury).

The years from 1680 to 1700 marked more arrivals. Bloody Point became a separate parish in 1713 and its name was changed to Newington (Rowe 1987). In Dover, settlement expanded further north with the arrival of the Quakers, who met with an unfriendly welcome and proceeded up the point where they built another meetinghouse, thereby expanding the original settlement (Hurd 1882). This period also included war between the English and Native Americans, known as the French

and Indian War, during which a militia was enacted by the colonial government. A period of skirmishes followed resulting in construction of garrisoned enclosures here (Rowe 1987; Scales 1923; Wadleigh 1913).

By the 1700s, sections of Newington and Dover were well established and residents were participating in vast economic enterprises, as well as local and regional development. The local economy was based on farming and fishing. Foreign commerce was based on export of such natural resources as fish and timber, carried by ship to distant ports along the North American Atlantic coast, into the Barbadoes and West Indies, and across the ocean to England, Spain and Portugal (Scales 1923). Local developments included continued land clearing and farming but the lack of water power precluded establishment of mills here. In 1710, the Newington Town Forest was established on 112 acres in three tracts including the Church, Parsonage and Downing lots. This land was held as timberland for public building construction and to provide the poor with firewood (Rowe 1987:79). In the 1790s, the First New Hampshire Turnpike and the Piscataqua Bridge were constructed, allowing a connection between Portsmouth and the interior of New Hampshire. This was built by a group of private investors and followed a route between Fox Point in Newington to Cedar Point in Durham, crossing Goat Island (Bolster 2002). Development followed this corridor, with farms, residences and taverns built along the route (Garvin and Garvin 1988).

In the 1800s, farming was the principle occupation of Newington and Dover Point residents. Crops included apples, corn and potatoes along with vegetables and dairy farming completed the scene (Rowe 1987). To the north, water power at major falls was used in development of mills. The economy of Dover, therefore grew through the textile industry. In contrast, mills did not develop in the Dover Point locale; instead brickyards were in operation here throughout the nineteenth century. A demand for brick as a building material followed the Great Portsmouth Fire of 1813, in which 15 acres of property were demolished in the city. Brick yards operated for several generations and were situated along the entire length of Dover Point, where clay was available. Clay was extracted and processed, then fired into brick, producing some 7 million bricks in a single season at the height of operations in the mid to late 1800s (Adams 1976; Rowe 1987; Scales 1923).

While ferry service was in operation between Dover Point and Newington since the 1600s, it was not until 1873 that a bridge connected the two. This was built in conjunction with the Portsmouth & Dover Railroad, chartered in 1866, and opened in 1873. The line paralleled the Piscataqua River through Newington and crossed to Dover Point. It was built to provide access to the productive farmlands of Dover and the grains grown there by Frank Jones, who operated a brewery to the south. The bridge included a rail and carriage road with a swing draw for river traffic (Rowe 1987). Stations and depots were built along the route and a popular inn, known as "Hanson Hotel" "Dover Point House," and, later, "Hilton Hall," was built in 1854 by John P. Hanson on a prominent spot at Dover Point.

By the twentieth century, new industry and development came to Newington and Dover Point. Homes were built and neighborhoods developed, summer visitors were attracted to the shorelines. In 1933, a highway was extended across the river and the railroad removed. The economy shifted from agricultural to commercial and industrial. At the time of World War I, the Shattuck Shipyard was built in Newington. Other industries developed along the railroad line and a huge portion of Newington was taken for military development in the 1950s. The Piscataqua River was dredged, larger ships entered the area, and soon highways, interchanges and shopping malls appeared (Bolster 2002; Rowe 1987; Switzer 1998).

Today, portions of the original natural landscape and the historically developed cultural landscape remain intact today. Parkland and open space is found in sections of Newington and on Dover Point. Yet much of the area has witnessed extreme development erasing the vernacular of the past.

Historic Themes

Several unifying themes help explain the history of Newington and Dover Point by providing a larger interpretive context, independent of culture chronology. The historic themes which pertain to known and likely archeological resources within the study area include: maritime adaptation; first settlement; transportation; and economy. Each theme is linked to the others and all ebb and flow over time.

Maritime Adaptation

A maritime context provides the over-riding theme for both Newington and Dover Point throughout the historic Euro-American period. The river, estuary, bay and sea pervade all time periods and links people's settlement, transportation and economy through time. It was by water that the first Europeans accessed, explored and settled the area. The earliest economic enterprise was fishing. The river continued to be important in subsequent economies, playing a role in such enterprises as shipbuilding, marketing, and economy both for cash, barter and domestic use. Even the production of brick is linked to the sea and the river: clay, the very natural resource used to make brick, was deposited during marine events and brick, the final product, was transported from brickyards to market by boat. The role of the Piscataqua River, Great Bay and the Atlantic Ocean is elaborated in individual contexts below.

First Settlement

The first European settlement on the New England coast focused on the sea and its bountiful fishing resources. The settlement locations along the Piscataqua River and within Great Bay fall within a clutch of early 17th century settlements along the New England and Mid Atlantic coast. Locally the settlements are known today as Pemiquid, Portland, Portsmouth, Newburyport, Salem and Boston. These early settlements can be characterized as communities established to conduct specialized trade for the British Empire. English settlements in New Hampshire were established

first as fishing outposts and later as lumber and timber contracts under the reign of James I.

At Hilton Point, Edward Hilton, a son of a fish monger and a member of the London's Fish Monger's Guild came to settle his 500 acre claim along the Piscataqua River within the Gulf of Maine. The Fish Monger's Guild was well familiar with the coast of Northern North America, for it was the Guild that controlled the fishing industry between Newfoundland to the New England shore, under the jurisdiction of John Mason. Hilton sailed four miles up the Piscataqua River from the newly established community of Strawbery Banke (modern Portsmouth) and 11 miles from the Isle of Shoals.

Once Hilton arrived at Dover Point, he began to establish his fishing station and provide for the community. This required a dependence on many sources including: trade with existing European communities; coastal and transatlantic shipments; and securing local goods from both the English and Native Americans. While the occupants of Hilton's settlement interacted with Native Americans, this was influenced by two major factors. First, the Native American population in the seacoast region was so reduced by 1633 that less than 90% of the Native American population before European contact survived Second, the English interacted with the Native Americans quite differently than the French and Dutch of earlier times in that the English saw themselves as separate from Native Americans; the English viewed themselves as civilized people of God and the Native Americans as savages to be converted (Harrington 1985; Goodby 1998; Snow 1980).

The fishing station established by Edward Hilton was inventoried in 1637. This inventory gives us an understanding of the nature of the settlement, its purpose and size. The nature of the settlement can be compared with Portsmouth's inventory for the same year. An inventory and provisions in the early colonies of Newichewanock (South Berwick) and Pascatway (Portsmouth) taken in 1635 and transcribed in 1847 provides information on the structure and nature of these two early settlements which were compatible to Hilton Point. This inventory was taken in July when supplies were being delivered to Capt. Walter Neal, of Strawbery Banke, for subsequent delivery to Henry Jocelyn by the command of John Mason.

The inventory for Portsmouth includes: arms and ammunition; stores; provisions; cattle; fishing trade; and items for religious use. The items listed as "stores" and "fishing trade" show which tools were needed to conduct fishing in the Piscataqua. They included: Pitch, tar, "quoils of rope" and cables, Herring netts, codlines, Mackrill lines, Gang cod hooks, 30 doz. Mackrill hook, squid lines, 70 knots of twine, 1500 Boards and 1511 pine Planks. For the fishing trade there were 6 Great Shallops, 5 Fishing boats with Sails, Anchors & Cables and 13 skiffies. This inventory further reflects that after 15 years, Portsmouth was a substantial station, being re-supplied with considerable goods. At this station, cod, squid, herring and mackell were being caught and processed for the English market across the Atlantic.

Portsmouth's relation with Hilton's settlement was tenuous at best during this time. Walter Neal and Thomas Wiggin averted a dual at Bloody Point; following an argument over whether to have Hilton's settlement join with those at Portsmouth. This confrontation reflected on-going political battles concerning authority for establishing fishing stations in the region

Fisheries of New England no only supported the colonial settlements but also exported processed fish to England. However, the economic dominance of fishing was soon overshadowed by awards of Naval Contracts to the Wentworth Family, prominent in provincial politics. The contract to supply the British Navy with trees for masts focused entrepreneurial efforts to the interior wilderness. Thus, the role of fisheries began to diminish and fishing became a subsistence activity practiced by individual families. Commercial enterprises began to move gradually up the coast to the north, along the Maine and Canadian coasts.

Excavation of archeological sites related to the extended Hilton family and their heirs, has also provided data for comparison. Edward Hilton's extended family settled in the region; his brother received the Squamscot Patten, along the Squamscot River, in an area which is part of modern Newfields. The Hilton family and subsequent generations solidified their alliances within the region through marriage to families who held land and operated fisheries as far north as Newfoundland. Excavation at some of these early historic sites has revealed much about 17th century life in the Piscataqua Region (Baker 1994 and Baker, *et al*. 1992). Households consisted of extended kin-aligned groupings, with wealth amassed in personal possessions and landholdings. The Charbourne site, excavated in South Berwick, Maine, is recognized as an earth fast building, burned in a 1690s "Indian Raid." The site contained charred material goods and stores kept by a wealthy family in the Piscataqua Region during the late 17th century (Baker 1994 and Baker *et al.* 1992).

First settlement around Great Bay resulted in the clearing of land and planting of European crops that shaped the nature of the landscape and the plant communities growing today. While Native Americans cleared portions of Newington and Dover before European settlement for cultivation of crops and to increase habitant for game, land clearing was expanded by Europeans through the cutting and burning of the scrub oak and associated vegetation. Sawmills were established in portions of the estuary where waterpower was available. Large timbers were either processed on site or floated to mills for cutting. International and coastal trade in barrel staves, house frames and furniture all worked to deplete the forest resources with in the Great Bay. As settlement increased and the demand for timber and firewood increased lumber and wood was sought north and west of Great Bay.

Within a generation of the original 1620s settlement, Native American survivors had regrouped and formed an alliance of traditional groups to form the Cocheco Indians. These Indians made treaties with the French and the English, who in turn broke them. By 1675, Native Americans began a series of raids on English settlements in part inspired by the French military. The settlers at Hilton and Bloody Point along

with their neighbors in Berwick, Maine and Oyster River and Dover fortified their homes and meetinghouses with as garrisons. These were palisaded structures of vertical boards with observation towers and a single gated entrance built around a home, group of homes, or meetinghouses. These fortifications were necessary for life in the Great Bay region in the late 1680s and early 1690s. Instigated by the rivalry of the French and English and fueled by the fighting of Queen Anne's war, Native American raids of garrisons were frequent. Isolation left settlers vulnerable to attacks. In the 1670s and 1680s raids were conducted in Greenland, Hilton Point and Bloody Point as well as at Cocheco (Dover), Salmon Falls (Rochester) and Oyster River (Durham). The leader, Hope Hood also led an attack at Fox Point in Newington (Rowe 1987).

Garrison Houses were constructed as a form of protection from attacks. While several garrisons were built in the Piscataqua region, few survived the period and even fewer remained 100 years later. At least five garrisons were built in Newington, with the Lanstaffe garrison standing on Bloody Point.

The Whipple Garrison in Kittery, Maine, provides comparison and is described as:

> *"The garrison part of this house was constructed of hemlock timber hewed square, dove-tailed together at the corners; when the present owner put the building in repair, this timber was found to be perfectly sound, and likely to last for centuries unless destroyed by fire… The form of the building was doubtless copied by the colonists from European houses, in which projecting upper stories were common; and the preference for timber over stone probably arose from the destitution of lime in early days.*
>
> *For very obvious reasons, they had but few windows, and those of small size, especially in the lower part of the house; and these furnished with strong shutters. The door was a ponderous thing, in some cases made of timber or joist, sometimes of oak, and not unfrequently hung on wooden hinges; generally, but not always, opening in two parts, well braced and barred.*
>
> *Every neighborhood, of three or four farm houses, used to have one of them a garrison house, built in this way by the united efforts of the neighbors, but held as the private property of one man, and used as the residence of one family. In times of apprehended danger nearly or quite all the neighbors lodged at the garrison"* (Brewster 1971-1972).

Meetinghouses were the second form of community meeting place to be established during this first period of settlement. Meeting houses served as places of worship as well as governmental meeting places. In Newington, the Meeting House was established in 1713, and marked the separation of Newington from the grant of Portsmouth and Dover. The establishment of the Newington Meeting House coincides with the time of settlement and is significantly different from other early settlements that did not establish meetinghouses early on. By establishing a Meeting

House, Newington created a separate governmental identity through a symbol of its newfound independence.

The Dover Point Meeting House was built *ca.* 1689. It is depicted in a drawing (Wadleigh 1913) showing that it stood alone, surrounded by a palisade fence. The Pinkham Garrison is recorded nearby, but these structures were no longer standing by the first decades of the nineteenth century.

By the beginning of the 1700s a new day of settlement and economy had arrived for coastal New Hampshire. Increased population size, demand for land, and trust that the Native American raids were diminished brought settlers to Portsmouth, Dover and Newington. Accompanying this change was also dividing and selling large parcels of land into small urban lots and farms of 50 to 100 acres size. These changes mark the end of the First Settlement period.

Transportation

By Water: Boats

Transportation in Great Bay and the Piscataqua Region, was based on a complex network of international shipping, coastal trade and tidal river drainage into the Gulf of Maine. Portsmouth Harbor was a good natural harbor because it offered deep water, rarely froze and the current and tides permitted vessels to quickly enter and exit. Further from the sea, tide and currents also controlled access to Great Bay settlements.

The vessels used for travel during the 17th century were schooners, shallops, and smaller fishing boats. They found access to the interior along coastal river tributaries. It was these ships that brought Edward Hilton up the Piscataqua to Dover Point.

These sailing vessels also carried cargoes of manufactured goods to the region from England and other ports of the British Empire. They were then reloaded with the new colony's products especially, furs, timber and fish. Alewives and other fish were salted and shipped by barrel to the West Indies and apples were shipped to London. Sailing vessels were loaded and off-loaded by use of gundalows, a vessel designed to carry heavy loads and navigate the current, tide and narrow passages (Adams 1976: 158, 184; Gowell 2002:111).

Great Bay and all of its seven tributary rivers are tidal until each river meets a natural falls; consequently smaller craft were all dependent on the tide. The tide changes daily, with a slack and ebb tide for each portion of Great Bay. The tidal action combined with the narrows between Dover Point and Bloody Point still makes for very treacherous sailing, with one of the strongest currents found in New England waters (Gowell 2002:111). Therefore, the scheduling of boat launch and arrival times was a complex fluctuating cycle, leading to a very small and locally based transportation network comprised of ferries, gundalows and other private boats.

A locally derived watercraft was the simple gundalow. This vessel has a shallow draft, and was originally undecked. It was used in this region with great success because it could be propelled in several ways. First, it was able to utilize the fast tidal currents of the Piscataqua. In addition, the vessel could be rowed in restricted waters and sails could be hoisted to aid in power. The vessels were loaded with cargo and people and provided transport throughout Great Bay into Portsmouth. The gundalow was an essential watercraft for the Great Bay from the 1660 to the late 19th century (Gowell 2002: 111-112).

Ferries and private boats provided connection between the land and the river, Portsmouth harbor and the Isle of Shoals. Ferries in the seventeenth century connected points of land and coves that ring Great Bay. Wharves and landings were constructed on these many points of land. The ferry between Bloody Point and Dover Point was established by Tricky as early as 1640 and purchased by John Chevalier (aka Knight) a French Huguenot in 1705 (Ewing and Chesley 1981:2). This and other ferries provided the web that connected people and goods throughout the region.

By Land: Roads, Railroad and Bridges

Transportation networks of the seventeenth and eighteenth centuries focused on the waterways of the region. By the end of the 18th century, settlement had expanded into interior regions that were not as easily accessed by navigable waters. Paths and cart paths were used more and more with less and less success. Travel between Durham and Concord was more in demand. The solution was to build a turnpike to connect Oyster Falls and hence Great Bay and the seacoast to the interior. The First New Hampshire Turnpike was established in 1794; it connected Durham and Concord and brought the stage from Boston to Portsmouth, then on to Dover and back. These systems were privately run enterprises and tolls were collected to fund their operation. Although built by entrepreneurs, the operations were regulated. The turnpike system and the stagecoach routes brought great changes in transportation, particularly for residents of the seacoast (Garvin and Garvin 1988).

The Turnpike was expanded to extend over Great Bay. This expansion, while costly, greatly reduced the time to travel between Portsmouth to Durham. Plus, travelers were not dependent on the tide, water conditions, or weather. Thus, the original Piscataqua Bridge was built in 1794 and was paid for with a lottery. This bridge connected Fox Point in Newington to Cedar Point in Durham via Goat Island. It was a beautiful structure, with a graceful arch and white rails, spanning a distance of 2600 feet. It stood until 1855, and its remains are preserved underwater (Switzer, 2003, pers. com.).

The second bridge to be built was a combination railroad and road bridge that spanned the mouth of the bay between Newington and Dover Point. This bridge was built in 1873 by a private investor, Frank Jones. Jones was a brewing tycoon who used the rail to move goods and products in and out of Portsmouth and to access

crops grown in Dover. The railroad came to Dover and Newington late in rail history, and had already been established in Portsmouth by 1840. Its appearance here also opened the way for industrial production of the late-nineteenth century. Portsmouth, Newington and Dover Point had not been part of the earlier industrial development that was seen in elsewhere in Dover, Somersworth and Rollinsford.

The third bridge constructed here followed and replaced the railroad. This was the modern General Sullivan Bridge, completed in 1934. Finally, the present-day bridge was constructed in the 1960s. These twentieth century bridges remain standing today and have effectively replaced travel across the water by ferry, gundalow, skiff, or other craft (Garvin 2002 100-103; Ewing and Chesley 1981:2).

Even when the waterways were not the primary source of transportation, paths, roads and rail networks conformed to them. The land transportation network continued to expand as roads were built into parts of the region not accessible by navigable waters. The closer to Portsmouth the more diverse the road system was. In Newington, major roads led to and from Portsmouth, with spurs providing overland connections. At Dover Point, the major roadways followed the spine of the point into Dover before branching off. The road pattern reflects the nature of settlement and land and shore use through historic and pre-contact periods. The constant pattern of the road traveling down "the spine" reflects the lay of the land and the location of resources to be accessed at the Point and in the Bay.

Economy

The local economy was dominated by fishing, agriculture, shipbuilding and brickmaking. These elements, while each important in its own right, have fluctuated over time in their economic importance to the region. The economy also depended on movement of goods and people into the area and was closely tied to travel and transportation routes. Of course, people practiced many other activities as part of their daily lives. People traveled to the shoreline for outings and picnics, using the railroad, and stayed at the Hilton Hall, a nineteenth century inn at the tip of Dover Point. Excursion boats were popular along the river, and parties sailed, hunted and fished here for sport. The fishing and farming of the earlier phases of Newington and Dover Point's histories was replaced by one comprised of industrial, military and commercial elements in the twentieth century.

Fishing and Farming

A mixed fishing and farming economy was conducted in this area of Great Bay that echoes the economy practiced in the lowlands of England and the coastal region of Bristol and northern British Isles. A certain perception of work and living was brought with the eighteenth century English folk who resided here. This British Isles tradition is based on family ties and daily routines, and not on abundance of material culture. Farming and fishing were successful economic strategies until the 1950s when the land was taken for the establishment of Pease Air Force Base.

English settlement of the region was first established in order to meet the demands for fish. New England and North Atlantic waters contained the fish resources necessary for the English market. Thus the first fishing stations and settlements were supported by Queen Elizabeth and King James and served an international market. At Hilton Point, a cod fishing station was established in conjunction with other plantations established in the 1620s (Harrington 1985).

Throughout the 19th century, fishing continued as an important economic element. Smelt, alewives and eels were caught during the winter months, and were then smoked, brined and sold (Adams 1976:149). The seasonal nature of the fisheries complimented the other economic elements used by the residents of Dover and Newington. Among these was agriculture. Farming in Newington and Dover Point followed patterns of the small-generalized family farm. Mixed crops were grown and included potatoes, corn, apples, grains and vegetables. While crops were grown as "cash crops" and for trade, family substance was provided for with dairy products, meat, eggs and vegetables. Dairy cows, chickens and hogs were the livestock raised for home and market production. In contrast to other coast New England farms, salt marsh was not a primary endeavor.

Fishing and farming were not singular activities. They were woven into a complex economic strategy of trade, barter and sustainability. Records indicate that crops, fish and moonshine were often traded (Adams 1976:263; Bolster 2002:105). Cartographic data show that the family networks of the property ownership, trade and social networks are all closely aligned. Nineteenth century maps indicate that people of the same extended family occupied adjacent parcels of land for long periods of time and that farms included numerous barns, sheds and structures for diverse activities.

People's occupations in the past were both seasonal and resource specific. In the summer, people farmed their land and in the winter people turned to fishing and woodworking. "If any farmer had any time in the winter he used to make barrel staves, hoops and stuff… used some oak…some pine…put our apples in" (Adams 1976:184).

Shipbuilding

"Shipbuilding was a way of life on the Piscataqua" (Leavenworth 2002:89). Shipbuilding began as early as 1644 in the region and was an important aspect of economic growth from the 17th to 19th century. Boats of all types were essential to life here; they carried the earliest explorers into the region, they carried fishermen and their catch, and they carried goods, people, animals and products through Great Bay and along the Piscataqua River.

Early boat building was small scale. All that was needed to build a boat was access to water, the tool kit of saws, planes, adzes and drills, the materials and skill needed for boat building. And many boats were built, including ferries, lighters and the gundalow, known as the work-horse of the Piscataqua.

In the nineteenth century the ships became larger, hulls had greater draft, and deep water was required for launching. Therefore, ship yards were located closer to the coast where the waters were deeper, particularly at Kittery, Elliot and Portsmouth (Leavenworth 2002:97-99).

World War I marked the final episode of shipbuilding in Newington at the Shattuck shipyard on the Piscataqua River. The Shattuck Shipyard built wooden freighters, weighing 3500 tons and measuring 270 feet in length. At any one time, six ways were in operations with vessels at various stages of completion. The yard launched fifteen vessels in 1918 and 1919, with the Newburyport, their final launch in August of 1919. Today, the yard is located within the Piscataqua Power Plant property and consists of a jumble of timbers associated with structural assemblages, freighter remains, and abandoned buildings (Adams 1976; Switzer 1998). The shipyard attracted thousands of workers who resided in the fields surrounding the yard; its operation paved the way for future industrial development in Newington (Bolster 2002:105).

As ships grew in size, the waters and shoreline of the Piscataqua also changed. Shoals in the Long Reach were dredged, oil tankers now dock at terminals. Boiling Rock was blown up to remove a navigation hazard. Yet, along with its removal was the loss of a cultural landmark. Gundalow drivers calculated that passing Boiling Rock marked the "halfway" point, "no matter where they were going" and provided a reason to celebrate as "everybody would have a drink aboard the ship that they'd safely passed the Boiling Rock" (Adams 1976:144; Bolster 2002).

Brickmaking

Brickmaking became an important industry in Newington and Dover Point during the nineteenth century. Successful brickmaking depended on several variables, all of which were present in the area. First, a reliable source of high quality clay is needed. This must be accompanied by sufficient open acreage for extracting and processing the clay, for forming and drying the brick, and for firing. Wood is also needed to fuel the kiln. In addition, labor and market are necessary, as is a transportation route to move the brick to the market.

An excellent source of marine clay was present along the shorelines, particularly along Dover Point. This clay was extracted by horse and hand, and shaped into bricks which were dried and fired on site during warm and dry seasons of the year. Firewood was cut from adjacent woodlots during the winter. Gundalows transported the brick downstream. And bricks were in demand. They were shipped to Portsmouth following a massive fire in 1813 and also to the Boston market (Adams 1976; Garvin1994; Goldthwait 1953; Rowe 1987; Scales 1923).

Brick was made here for generations, with families well known for their brick yards. At Dover Point, the Pinkham's began brickmaking in 1830 and continued for four

generations"right down to the bridge … until they used up all the clay"(Adams 1976:109). Production was enormous, with up to 7 million bricks made at a single brickyard in one season (Rowe 1987:181).

Euro-American Site Summary and Expectations

Evidence for hundreds of years of Euro-American occupation is visible in many ways throughout the study area. The position of roads, bridges and buildings reflects the historic settlement pattern and standing historic structures are still present here. Other evidence is found in the form of ruins and archeological remains. Sites are known to exist in Dover and Newington, despite the effects of erosion and massive modern landscape alterations.

Several sites have been previously recorded in the study area in the NH Division of Historical Resources site files. Among these is a cluster of foundations, dumps and other features discovered during cultural resources management survey for Pease Air Force Base. These sites include: a foundation; two dumps; a foundation; a spring; and a road grade and culvert feature. Investigations of these resources lead to a determination that none of them exhibited qualities to make them eligible for inclusion to the National Register of Historic Places. Elsewhere, other sites have been previously recognized in Newington. These include: a house foundation site on Fox Run Road, including elements associated with the Newington Railroad Station; at Tricky's Ferry Landing; and assignment of designation for two foundation sites that are not coordinated with mapping. In addition, records of the NH Division of Historical Resources note that Hilton's Point is considered archeologically important. The Shattuck Shipyard site was recorded in 1998 (Switzer) but is not designated with a NH Division of Historical Resources site survey number.

On the basis of information collected from numerous primary and secondary sources, we may expect to discover Euro-American sites, features and artifacts throughout the study area. Locations of particular sensitivity for these resources include any undeveloped tracts and shoreline sections which have not been impacted by modern growth and development and remains of subsidiary structures on built tracks. Sites and components may reflect a long chronological sequence, from the 1620s to the 1900s, and may contain artifacts and features reflective of an array of past activities. Sites or components may reflect the following contexts: first settlement, fishing, farming, commerce, trade, ship building, brickmaking, recreation, travel or other activity. Types of artifacts and features may vary considerably. First settlement meeting houses or garrisons may contain a composite of Native American and early Euro-American materials, and there may be evidence of earth-fast construction. Fishing stations may contain elements of drying racks, wharves, tools and structures. Nineteenth century farms may contain very few artifacts reflecting a non-materialistic way of life, but may include such remains as foundations, landscaping, trash pits, and scatters. Industrial sites may contain work yards, tools, raw materials, including brick at brickyards, timber at shipbuilding sites, and building remains. Further, many sites may be expected to contain overlays reflecting

multiple use and activities deposited over the course of several hundred years. Overall, the historic period archeological record is expected to be complex.

Underwater and nautical archeological resources survey did not reveal archeological resources of a maritime nature, such as shipwrecks or vessel remains, deposited within the channel of the study area. This is due in part to the make-up of the substrate of the Bay and river bed. With the exception of the shallow margin areas composed of mud, sand and crushed shell, the deeper areas that extend into the wider channel are rock strewn. The channel bottom is composed of tightly packed cobbles with interspersed boulders. This mixture has created a surface that defies penetration or imbedding, that, in turn, negates the possibility of preservation of wooden remains, including the hulls of vessels. Further, the current, which at ebb and flow flows at a rate exceeding 6 m.p.h., has scoured the bottom of any submerged resources. The features observed along the channel bottom include such objects as trees, branches, and items of great weight such as I-beams. These are considered anomalies, lying "captured" by bottom conditions. Therefore, the conditions in the study area do not exhibit the potential to allow the retention of marine-related archeological resources constructed of wood.

Underwater resources are expected where they have withstood the effects of tide, storm and current. Such resources, which constitute features of the past historic built environment, were noted during survey for marine resources. These include elements both underwater and at the shoreline margins such as: foundations associated with the former railroad bridge; a ferry landing; and a ship yard.

Remains of the former railroad bridge were noted in the maritime archeological survey (**Figure 3.13-2**, Area 22). These included pilings and draw bridge support foundations along the former railroad corridor. A portion of the abutment constructed of cut granite block riprap around wooden pilings was observed along the shoreline at Bloody Point and pilings were observed in riprap on the shoreline at Dover Point. In addition, video camera track data revealed submerged granite with drill marks, representing sections of underwater bridge pilings in the river channel.

Other related resources included the Tricky's Ferry Landing (Area 23) and the Shattuck Shipyard (Area 67). The Tricky's Ferry Landing was observed along the shoreline and includes remnants of a jetty constructed of stone. The Shattuck Shipyard includes remains of wharves, pilings and abandoned, unfinished vessels.

Interpretations

In the Newington and Dover portions of the study area there are many elements and resources that reflect human settlement and adaptation in the Great Bay and Piscataqua region over a period of thousands of years. These are preserved as standing structures, ruins, features and archeological sites. The cultural landscape changed over the course of 10,000 years, due to continuous occupation and landscape use through both pre-contact and historic periods.

Archeological research and field investigation within the proposed study area have documented a long and varied sequence of past human use, by both Native American and Euro-Americans. Past landscape manipulation here is extensive, with evidence of settlement, industry, farming, travel and commerce. The scale of recent commercial, industrial and military alterations is believed to have disturbed and erased many potential types of archeological resources. However, sectors of the study area are believed to contain important in-ground remains and resources.

The components and resources recognized during archeological survey provide information of the past cultural landscape and history of the study area. They reflect settlement and land use in the locale. Survey has confirmed the following:

Pre-contact Native American archeological sites have been recorded throughout Great Bay and the Piscataqua drainage. Several sites are known to exist in close proximity to the study area. A single site was previously recorded in Newington, within the study area but was determined not to exhibit eligibility status to the National Register of Historic Places. Research also revealed that pre-contact Native American sites may be expected throughout the study area, particularly along shorelines and stream margins. While areas exhibiting sensitivity for the occurrence of pre-contact Native American sites have been delineated throughout the study area, no new sites were recorded during the current survey.

Historic period Euro-American archeological sites have been recorded in and near the study area. These include foundations, dumps, agricultural features and sites associated with the railroad and ferry. In addition, two locations (Hilton Point and the Shattuck Shipyard) have been recognized as important archeological areas but not are not recorded as sites in the NH Division of Historical Resources statewide site inventory. Six historic period sites were previously recorded in Newington and include foundations, dumps, farm roads, a spring and a culvert but were determined not to exhibit eligibility status to the

National Register of Historic Places. Other previously recorded historic period sites in the study area include additional foundations, features associated with the railroad and Tricky's Ferry. Current investigations documented the occurrence of eleven additional historic period sites or features including: brickyards (Areas 7, 8, 13, 17 and 21); house foundations (Areas 1, 58 and 23); a spring (Area 9); and graveyard (Area 39); and a drive-in theater (Area 21). In addition, other areas exhibiting sensitivity for the occurrence of historic period Euro- American sites have been delineated throughout the study area, including locations on land, at the shoreline margin and underwater. These locations reflect landscape use for first settlement, fishing, agriculture, industry and travel by road, railroad, and water.

Phase I-A archeological resources survey has verified the occurrence of numerous known and likely archeological resources throughout the study area. These resources encompass 10,000 years of human occupation at the mouth of Great Bay and range

New Hampshire DOT
Department of Transportation

PORTSMOUTH
NEWINGTON
ROCKINGHAM COUNTY
STRAFFORD COUNTY
DURHAM
DOVER
NEWINGTON
NEW HAMPSHIRE
MAINE
TOLL PLAZA

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- VERIFIED SITE
- VERIFIED SITE, NOT ELIGIBLE
- AREA EXHIBITS SENSITIVITY FOR OCCURRENCE OF ARCHAEOLOGICAL RESOURCES
- AREA EXHIBITS PROBABLE SENSITIVITY FOR OCCURRENCE OF ARCHAEOLOGICAL RESOURCES BENEATH VENEER OF VISIBLE DISTURBANCE
- AREA LACKS INTEGRITY AND DOES NOT EXHIBIT SENSITIVITY FOR ARCHAEOLOGICAL RESOURCES
- WATER
- HISTORIC ROADS AND RAILROAD

N

0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.13-2
Areas of Archaeological Sensitivity

Note: Refer to appendix E of the scoping report for information on each number map unit.

from pre-contact and proto-historic Native American sites to sites and features associated with a wide range of Euro-American activities from the 1600s to the present day.

3.14 Potential Petroleum and Hazardous Materials Sites

An assessment of potential petroleum and hazardous materials sites was performed to identify existing conditions including the release or threat of release of oil and/or hazardous materials (OHM) within the study area. The scope for this assessment included a review of federal and state environmental computer databases; review of state and local records; site reconnaissance; and interviews with people knowledgeable about the study area.

File reviews were conducted to help identify properties within the study area that have had a release or pose a threat of release of oil and/or hazardous materials, and which may impact the environmental quality of the study area. Included in these reviews were federal and state environmental databases from FirstSearch[16] and the New Hampshire Department of Environmental Services (NHDES).

Additionally, a visual survey of the study area was conducted in an effort to locate potential petroleum and hazardous materials sites and to confirm the results of database reviews. Observations within the study area included several industrial properties, fueling facilities, former military activities, an underground petroleum pipeline, existing railroad rights-of-way, marinas and an aboveground tank farm. In addition to the file reviews and field survey, an interview was conducted with NHDES regarding sites associated with the former Pease Air Force Base (now the Pease International Tradeport), due to the special nature of this area.

The locations of the properties identified by these investigations are shown on **Figure 3.14-1**.

■

3.14.1 Confirmed and Potential Contaminated Sites

Resources contained within the environmental databases, included:

- National Priorities List (NPL);
- Comprehensive Environmental Response;
- Compensation and Liability Information System (CERCLIS);
- Resource Conservation and Recovery Act (RCRA);

▼

[16] First Search is a private computer database that contains and organizes information on potential petroleum and hazardous materials sites.

- Treatment, Storage, and Disposal (TSD) facilities list;
- RCRA generators (GEN);
- RCRA corrective action sites (COR);
- RCRA no longer registered (NLR) generators;
- State hazardous waste sites;
- State list of spills sites;
- Active Solid Waste Landfill (SWL) facilities;
- Registered underground storage tanks (USTs);
- Leaking USTs (LUSTs);
- Emergency Response Notification Site (ERNS).

Several additional databases were obtained directly from the NHDES including:

- Registered ASTs/USTs;
- Leaking storage tanks including: leaking underground storage tanks (LUST), leaking motor oil storage tanks (MOST), leaking above ground storage tanks (LAST);
- Hazardous Waste Sites; and Remediation Sites.

The FirstSearch™ report is available at NHDOT. Table 3.14-1 summarizes the sites identified within the study area.

Table 3.14-1
Confirmed and Potential Contaminated Sites Within the Study Area

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
Dover Point Rd	Dover	199902013	LUST RISK 6	Marina	1
			MOST RISK 8		
			UIC RISK 3		
		NHD073977340	RCRA -SQG (NV)		
		93-162	SPILLS-FIXED		
River Rd	Dover	94-328	SPILLS	Auto Store	NM
Old Rochester Rd	Dover	93-306	SPILLS	Tractor Trailer Truck	NM
Wentworth Terrace	Dover	199906016	LUST RISK 8	Pumping Station	4
Fox Point Rd	Newington	NHD008819526	RCRA –SQG (NV)	Boat Store	NM
		96-60	SPILLS-FIXED	Marina	
Fox Point Rd	Newington	199902026	GW HAZ INV - Closed	Estate	NM
		NHD986482610	RCRA – CEG RISK 8	Retail Store	
		NHD986474070	RCRA - CEG RISK 8	Auto Body Shop	

Table 3.14-1 (continued)

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
Fox Run Mall	Newington	199112005	LUST RISK 8	Retail Store	7
		199008035	LUST RISK 8	Retail Store	
		95-324	SPILL/RLS – FIXED	Retail Store	
		NHD986484509	RCRA –SQG (NV)	Retail Store	
		NHD510155344	RCRA -CEG (NV)	Retail Store	
		NHD510077118	RCRA –SQG (NV)		
		NHD986485589	RCRA –SQG (NV)	Retail Store	
		NHD981211949	RCRA -CEG (NV)	Retail Store	
Gosling Rd	Newington	NHD000842666	RCRA –SQG (NV)	Public Service	8
			RCRA –SQG (NV)		
Gosling Rd	Newington	NHD018960112	RCRA –SQG (NV)	Leasing Co.	9
Gosling Rd	Newington	NHD982200628	RCRA –SQG (NV)	Retail Store	10
Gosling Rd	Newington	H50339	ERNS – FIXED	---	11
Gosling Rd	Newington	199312028	LUST RISK 8	Retail Store	12
Gosling Rd	Newington	199807053	LAST RISK 8		13
Gosling Rd	Newington	199312028	LUST RISK 8	Retail Store	NM
			UIC RISK 8		
Gosling Rd	Newington	NHD986486009	RCRA -CEG (NV)	Tire Shop	15
Gosling Rd	Newington	199204011	LUST RISK 8	Service Station	16
		NHD986486132	RCRA –SQG (NV)	TOSCO	
		NHD092054899	RCRA –SQG (NV)	Service Station	
Gosling Rd	Newington	NHD510120637	RCRA –SQG (NV)		17
		94-336	SPILLS-FIXED	---	
Gosling Rd	Newington	NHD986474179	RCRA –VQG (NV)	Print Shop	18
			RCRA-TSD (NV)		
Gosling Rd	Newington	NHD500003579	RCRA –CEG (NV)	Truck Rental	19
Gosling Rd	Newington	NHD986470052	RCRA -CEG (NV)	Retail Store	20
Gosling Rd	Newington	426652, D50225	ERNS – UNKNOWN	Service Station	21
Gosling Rd	Newington	NHD000791491	RCRA –SQG (NV)	Public Service	22
			RCRA-TSD (NV)		
Gosling Rd	Newington	199112013	LAST RISK 6, UIC RISK 8	Marina	23
		NHD000791517	RCRA –LQG (NV)	Fuel Storage	
		240202, D30704	ERNS- FIXED	Service Station	

Table 3.14-1 (continued)

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
Old Dover Rd	Newington	NHSP-0203-I-99	SPILLS FIXED	---	24
Old Dover Rd	Newington	200106040	SPILL/RLS, UIC RISK 8	---	25
Old Dover Rd	Newington	198404023	GW HAZ INV – RISK 8	---	26
		NHD046312468	LUST RISK 8	---	
			CERCLIS –NFRAP	---	
			RCRA –SQG (NV)	---	
		NHD073962920	RCRA –SQG (NV)	Nuclear LLC	
		NHD986470144	RCRA –SQG (NV)	Shipping	
		NHD510131295	RCRA –LQG (NV)		
Old Dover Rd	Newington	NHD510173701	RCRA –CEG (NV)	Power Co.	27
		NHD510167653	RCRA –SQG (NV)	Power Co.	
		NRC578042	ERNS – FIXED	---	
				Building Materials	
Old Dover Rd	Newington	NHD986482552	RCRA –SQG (NV)		28
		NHD500014840	RCRA –SQG (NV)	Contractor	
Old Dover Rd	Newington	NHD058542044	RCRA –SQG (NV)	---	29
	Newington	NHD986482552	RCRA –CEG (NV)	---	
	Newington	94-319	SPILL/RLS – FIXED	Manufacturer	
Patterson Ln	Newington	NHD500022918	RCRA -CEG (NV)		30
Patterson Ln	Newington	199001012	LUST RISK 8		31
	Newington	199010083	LAST RISK 3		
			SPILL/RLS RISK 8		
			LUST RISK 8		
		NHD066754722	RCRA –LQG (NV)	---	
		NHD986472223	RCRA –LQG (NV)		
		NH2971590003	RCRA –LQG (NV)	Military Base	
			CERCLIS –NFRAP		
		97-68, 00-74	SPILLS-FIXED	Waste Facility	
		93-205, 94-316		Waste Facility	
		D50858, 436470	ERNS- NOT FIXED	Shipyard	
		463225, 426369	ERNS – UNKNOWN	Shipyard	
		D60196,468563		Fuel Storage	

Table 3.14-1 (continued)

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
		426597, D41607		---	
		NRC-524078		Military Base	
		D50085	ERNS - Unknown		
		X51473, 184364	ERNS – FIXED	Fuel Storage	
Newington Mall	Newington	199404004	LUST RISK 8	Retail Store	32
			LUST RISK 8	---	
		NHD085582443	RCRA –SQG (NV)	Auto Shop	
		NHD982203655	RCRA –SQG (NV)	Tire Shop	
		292661	ERNS – NOT FIXED	Delivery Service	
Newington Park	Newington	NHD073979676	RCRA –SQG (NV)	R&D Facility	33
		NHD088584719	RCRA –SQG (NV)	---	
Newmarket St	Newington	NHD8572824847	RCRA –LQG	NH ANG	34
Nimble Hill Road	Newington	198807012	UIC RISK NDY		35
		NHD986472017	RCRA –CEG (NV)	Manufacturing	
Pease Air Force Base	Newington	NHD510161391	RCRA –SQG (NV)	Military Base	36
		100330113	LUST RISK 8	Military Base	
		100330126	CERCLA RISK NDY	Military Base	
		100330123	CERCLA RISK NDY	Military Base	
		NH7570024847	NPL	Military Base	
			RCRA-LQG (RV)	Military Base	
		94-317	SPILLS/RLS FIXED	Military Base	
		94-142		Military Base	
Pease Air National Guard Base	Newington	199409078	SPILL/RLS RISK 8	Military Base	37
Pole NO. NEL-9/B&M R.O.W.	Newington	200106019	HAZWASTE RISK 8	Utility Pole	38
Off Portsmouth Ave	Newington	198404025	CERCLA RISK 2	---	39
River Rd	Newington	199311025	LUST,RISK 8	Pool Co.	40
		NHD043515865	RCRA –SQG (NV)	Pool Co.	
River Rd	Newington	198705051	GW HAZ INV, LUST RISK 6	Energy Co.	41
		NHD000477638	RCRA -LQG (RV)	Energy Co.	
		Several #'s	ERNS – FIXED	Energy Co.	
		581488, 499808	ERNS – UNKNOWN	Energy Co.	

Table 3.14-1 (continued)

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
		431141, D40758		---	
		431467, 540491	ERNS – NOT FIXED	Energy Co.	
		571352		Energy Co.	
		93-234, 94-253	SPILL/RLS – FIXED	Oil Co.	
River Rd	Newington	199411029	LUST RISK 8	Remediation Contractor	42
		NHD980521843	NH REG WASTE	Remediation Contractor	
			RCRA-TSD (RV)	---	
			RGRA-LQG (UV)	---	
		00-74, 93-205, 94-316	SPILL FIXED	Waste Facility	
River Rd	Newington	NHD986473577	RCRA –SQG (NV)	Auto Shop	43
Route 16	Newington	199101004	LUST RISK 8	Former Country Store	44
Spaulding Tpke	Newington	93-455	SPILLS	Tractor Trailer Truck	45
Spaulding Tpke	Newington	NHD982200628	RCRA –SQG (NV)		NM
Spaulding Tpke	Newington	481427	ERNS NOT FIXED	---	NM
Spaulding Tpke	Newington	94-328	SPILL/RLS	Auto Store	48
Spaulding Tpke	Newington	00-90	SPILL/RLS – FIXED	---	49
Spaulding Tpke	Newington	198909005	LUST RISK 7	Service Station	50
		NHD000003413	RCRA –CEG (NV)	?	
Woodbury Ave	Newington	571332	ERNS-FIXED	Unknown	51
Woodbury Ave	Newington	199201011	LUST RISK 7	Design Shop	52
Woodbury Ave	Newington	198905024	LUST RISK 6	Auto Dealer	53
			UIC RISK 8	---	
		NHD018962621	RCRA –SQG (UV)	Auto Dealer	
Woodbury Ave	Newington	NHD510093644	RCRA –SQG (NV)	---	54
Woodbury Ave	Newington	198706005	HAZWASTE RISK 3, LUST	Telecom Co.	55
			UIC RISK 8	---	
			SPILL/RLS RISK 8	---	

Table 3.14-1 (continued)

Address	Town	NHDES Site ID #	Database	Description	Figure ID # (See Fig. 3.14-1)
		NHD041463456	RCRA –LQG (RV)	Cable Co.	
		387527, H41440	ERNS – FIXED	---	
		387510		Fire Co.	
		92-31, 92-323	SPILLS-FIXED	Fire Co.	
		94-108		Fire Co.	
Woodbury Ave	Newington	NHD510157340	RCRA –CEG (NV)	Retail Store	56
		NHD500015862	RCRA –VGN (NV)	Retail Store	
Sprague Newington Terminal	Newington	445721		Marina	57

NOTES:
NFRAP - No Further Remedial Activity Planned
HAZWASTE - Site has non-petroleum related contamination (*i.e.,* chlorinated solvents). This type does not indicate severity of contamination, it is only an identifier of the type of contamination.
LAST - Leaking above ground bulk storage facilities containing motor fuel., LUST – leaking underground storage tank.
MOST - Leaking motor oil storage tank.
SPILL/RLS - Oil spills or release.
UIC - Underground injection control: discharges of benign wastewaters not requiring a groundwater discharge permit or request to cease a discharge (*i.e.* floor drain closure requests).
RISK – 1=Immediate risk to human health, 2=In well head protection area or within 1000' of well, 3=Free product or high level source, 4=Surface water impact, 5=Groundwater impact no alter. water, 6= High concentration, alter. water available,7=Low concentration, alter.water available, 8=No sources, no ambient groundwater quality standards violations onsite-remediation complete, NYD=not yet defined.
CEG- Conditionally exempt generator, VGN-very small quantity generator, SQG-small quantity generator, LQG – large quantity generator
NV - No violations listed, RV-resolved violations
TSD - Transport, storage or disposal
ERNS - Emergency response notification site
NM – Not Mapped. Site is apparently located in the study area, but the location cannot be mapped given currently available information.

■

3.14.2 Storage Tank Locations

Several identified aboveground storage tanks (ASTs) and underground storage tanks (USTs) are located within the study area, as identified by the FirstSearch™ and NHDES databases. Table 3.14-2 lists the tanks identified within the study area, while their locations are shown on **Figure 3.14-2**.

Table 3.14-2
Registered ASTs/USTs in the Study Area

Address	Town	Type	Facility ID	# of Tanks	Figure ID# (See Fig. 3.14-2)
Boston Harbor	Dover	UST	0111712	1	1
Dover Point Rd	Dover	UST	0112442	1	2
Wentworth Terrace	Dover	UST	0115223	0	3
Fox Run Mall	Newington	UST	0220275	0	4
Fox Run Mall	Newington	UST	0220272	0	5
Gosling Rd	Newington	UST	0220307	0	6
Gosling Rd	Newington	UST	0112801	0	7
Off Gosling Rd	Newington	AST	9712068	1	8
Gosling Rd	Newington	UST	0111448	4	9
Gosling Rd	Newington	AST	980841A	35	10
Old Dover Rd	Newington	UST	0110408	1	11
Old Dover Rd	Newington	UST	0112054	0	12
Old Dover Rd	Newington	UST	0111138	0	13
Old Dover Rd	Newington	AST	0000055	20	14
Patterson Ln	Newington	UST	0111536	6	15
Patterson Ln	Newington	UST	0111136	0	16
	Newington	AST	901083A	20	
Pease Air National Guard Base	Newington	UST	0114216	1	17
Pease Air National Guard Base	Newington	AST	940978A	17	18
River Rd Pumping Station	Newington	UST	0220274	0	19
River Rd	Newington	AST	991222A	1	20
River Rd	Newington	UST	0110779	0	21
126 River Rd	Newington	UST	0111942	0	22
	Newington	AST	870551A	32	
142 River Rd	Newington	AST	941129A	12	23
1149 Spaulding Tpke	Newington	UST	0111470	4	24
Woodbury Ave	Newington	UST	0220273	0	25
Woodbury Ave	Newington	AST	9812055	1	26
2025 Woodbury Ave	Newington	UST	0113896	0	27
2073 Woodbury Ave	Newington	UST	0110535	0	28
		AST	870605A	6	

New Hampshire DOT
Department of Transportation

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- (#) CONFIRMED OR POTENTIAL CONTAMINATED SITES

PORTSMOUTH
NEWINGTON
DURHAM
ROCKINGHAM COUNTY
STRAFFORD COUNTY
LITTLE BAY
PEASE BLVD
GOSLING RD
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
FOX POINT RD
FLAGSTONE BROOK
TRICKY'S COVE
NIMBLE HILL RD
FOX RUN RD
WOODBURY AVE
RIVER RD
SHATTUCK WAY
UNNAMED PONDS
BLOODY POINT
DOVER POINT
BOSTON HARBOR RD
POMEROY COVE
ROYALS COVE
SPUR RD
BELLAMY RIVER
TOLL PLAZA
HOMESTEAD LN
DOVER POINT RD
NEWINGTON
DOVER
PATTERSON LN
PAUL BROOK
GUILFORD RR NEWINGTON BRANCH
PISCATAQUA RIVER
UNNAMED PERENNIAL STREAM
NEW HAMPSHIRE
MAINE

0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

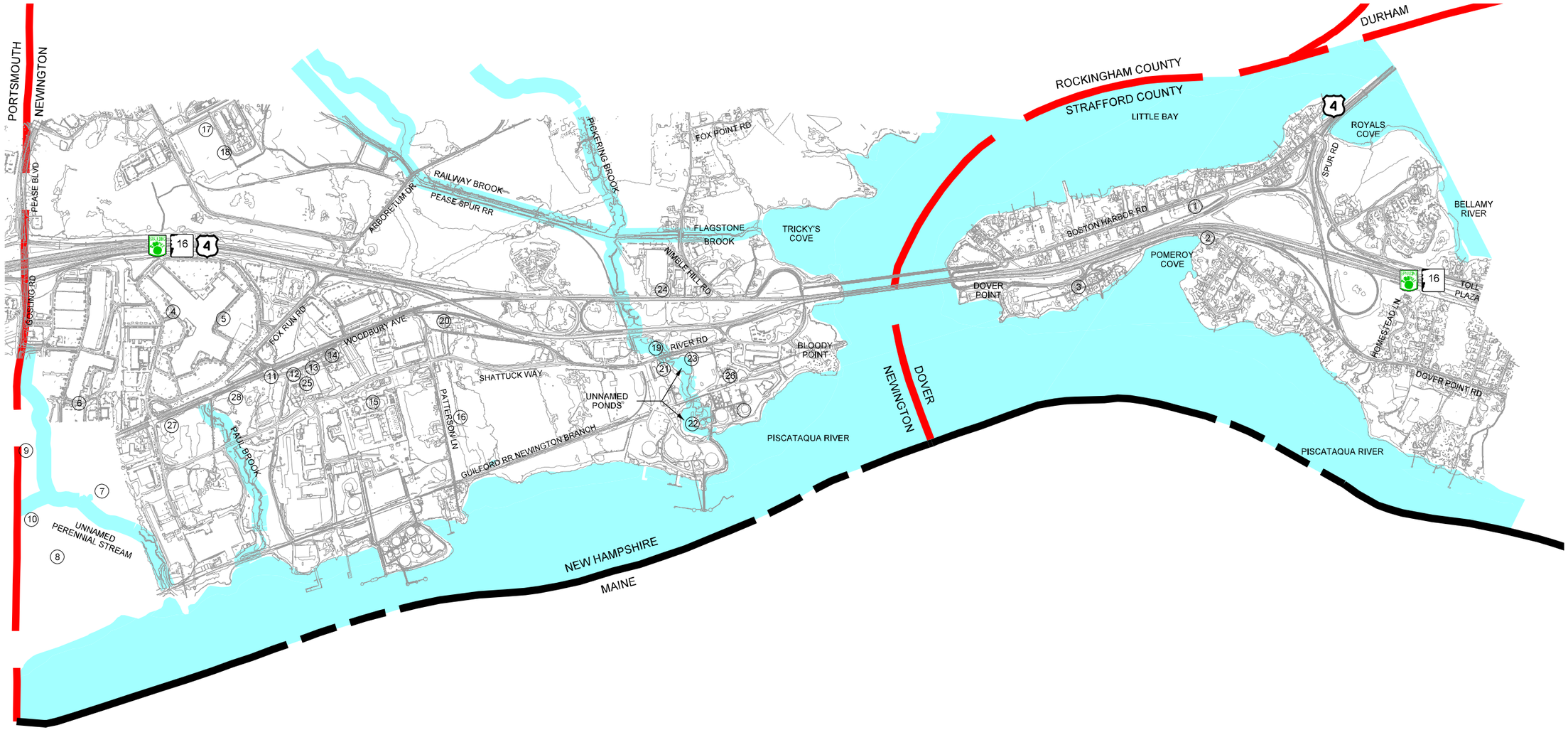
Figure 3.14-1
Confirmed and Potential
Contaminated Sites

Note: Refer to table 3.14-1 of the scoping report for site descriptions
Sites 2, 3, 24 and 47 are not mapped.

New Hampshire DOT
Department of Transportation

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- (#) REGISTERED AST/UST SITES



0 750 1500 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.14-2
Registered AST/UST Sites

Note: Refer to table 3.14-2 of the scoping report for site descriptions.

■

3.14.3 Summary of Findings

Although many potentially hazardous sites are present within the study area, certain sites may pose a greater risk of encountering contamination. For instance, the presence of a RCRA generator, UST, or AST site indicates that site activities for these properties include the use and storage of oil or hazardous materials, but does not necessarily indicated that a release to the environment has occurred. Sites that pose a greater risk are properties that have been identified to contain a reported release. These sites typically include NPL, CERCLIS, ERNS, State sites, and LUST sites. A description of site categories includes the following:

National Priorities List (NPL) – The USEPA's list of confirmed or proposed Superfund Sites. One (1) NPL site was listed within the study area, the Former Pease Air Force Base.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) – The USEPA's database of current and potential sites currently or previously under investigation. CERCLIS sites are classified as no further remedial action planned (NFRAP), not determined yet (NDY) and active. A total of five CERCLIS sites are listed within the study area, two are classified NFRAP, two NDY sites, and one is listed as active.

Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal (TSD) facilities list – USEPA's database of registered hazardous waste transporters and if violations have occurred at the site. Violations that have occurred at the sites are identified as resolved (RV) or unresolved (UV). There are a total of three TSD sites within the study area. Two of the three sites are listed with no violations, the remaining site is listed with a violation that has been resolved.

RCRA Corrective Action (RCRA COR) – USEPA's database that tracks specific corrective action events at a facility. No RCRA COR sites were listed within the study area.

RCRA Generators (RCRA GEN) – USEPA's database of all hazardous waste generators. The USEPA characterizes the generators by the volume of waste generated as CEG (conditionally exempt generator), VGN (very small quantity generator), SQG (small quantity generator), LQG (large quantity generator). The USEPA's database indicates if the generators are listed with violations along with the status of the violation. There are a total of 56 generators listed within the study area. Fourteen CEG sites, two VGN, 29 SQG sites and six LQG sites were listed without violations. Three LQG sites were listed with resolved violations and one LQG and one SQG were listed with unresolved violations.

Emergency Response Notification System (ERNS) – The USEPA's database of emergency response actions. Thirteen ENRS sites were listed within the study area. Seven of the sites are listed as fixed, four are listed as not fixed and two are listed as unknown.

State Sites – NHDES listing of hazardous waste sites, which are non-petroleum related release sites; spill/release sites, which are oil spills/releases; and groundwater hazard inventory sites. The NHDES database listing of all hazardous waste inventory sites as maintained by the Groundwater Protection Bureau and the Waste Management Division. There are a total of 21 spills/release sites within the study area, 14 of which are considered closed by the NHDES. Two hazardous waste sites exist within the study area.

Underground Injection Control (UIC) – NHDES listing of discharges of benign wastewaters not requiring a groundwater discharge permit or request to cease a discharge. There are a total of six UIC sites within the study area. These sites are assigned risk levels from 1-8 with 1 as an immediate risk to human health and 8 as no risk. Four of these sites are at a risk level of 8, one is at a risk level of 3 and one has not had a risk level assigned yet.

Active Solid Waste Landfill (SWL) – The NHDES listing of operating landfills that receive municipal solid waste maintained by the Waste Management Division. No SWL sites were listed within the study area.

Leaking Underground Storage Tanks (LUSTs), Motor Oil Storage Tanks (MOST), Leaking Above Ground Storage Tanks (LAST) – NHDES database listing of leaking storage tanks maintained by the Groundwater Protection Bureau. These sites are also assigned risk levels from 1-8 with 1 as an immediate risk to human health and 8 as very low risk to human health or the environment. There are a total of 25 leaking storage tanks within the study area. Eighteen of these sites are listed with a risk level of 8, two are listed with a risk level of 7, four sites are listed with a risk level 6, and one has a risk level of 3.

Registered Underground Storage Tanks/Aboveground Storage Tanks (UST/AST) – NHDES database listing of all registered storage tanks within the study area. The presence of a storage tank indicates the potential for a release. Twenty-nine storage tanks were listed within the study area.

3.15 Transportation

This section summarizes existing traffic conditions, levels of service, and infrastructure conditions and needs of the Spaulding Turnpike and its interchanges from Exit 1 at Gosling Road in Newington to Exit 6 at US Route 4 in Dover. The data

collection efforts include the New Hampshire Seacoast Travel Survey[17] (Section 3.15.1.1), vehicle classification counts, and weekday 24-hour, AM peak hour, and PM peak hour traffic volume counts. In addition, accident statistics based on state and local police reports have been reviewed and summarized.

The Traffic Volumes Section (3.15.2) summarizes existing 2003 traffic volumes, the results of the existing traffic operations evaluation, and the development of appropriate design hour volumes. In addition, Section 3.15.2 describes the traffic forecasting model used for this study and the future 2025 travel demand along the Turnpike.

The existing infrastructure conditions and needs assessment includes a discussion of the existing highway facility layout and identifies geometric deficiencies along the corridor. This assessment also includes a description of the pavement conditions and a summary of major bridge conditions within the study area.

■

3.15.1 Traffic Data Collection

Due to the size and scope of this study, an extensive data collection program was required. This information is crucial to determine existing travel patterns, characteristics, and facility level of service. The data collection program consisted of the New Hampshire Seacoast Travel Survey, and a compilation of traffic volumes and vehicle classification counts. Details of each component are discussed briefly below. Survey and count data were collected by the NHDOT, the Rockingham Planning Commission (RPC), the Strafford Regional Planning Commission (SRPC), and Resource Systems Group (RSG), acting as a consultant to the planning commissions.

3.15.1.1 New Hampshire Seacoast Travel Survey

In June 2003, the two regional planning commissions and RSG initiated the New Hampshire Seacoast Travel Survey. The survey was a web-based questionnaire that asked respondents for details on their most recent trip to the Seacoast area and what preferences they may have towards alternative ways of making this trip in the future (*i.e.*, commuter rail, express bus, car pooling, etc.).

A broad cross-section of respondents from the area population was obtained for the survey by recruiting at various locations including local public areas, toll booths, and public transportation centers. Recruiting methods at these locations included flyer handouts where respondents were provided with instructions to log on to the web

▼

[17] New Hampshire Seacoast Travel Survey, administered by Resource Systems Group, Inc., June 2003.

site from home or work and complete the survey at a later time, and face-to-face recruitment where respondents could take the survey on a laptop computer provided on location. In addition, various local businesses and municipal organizations also participated in the survey via email invitation.

From June 6, 2003 through June 23, 2003 approximately 58,845 flyers or invitations were handed out to participate in the survey at 22 locations. With an initial goal of 1,000 responses, the survey was successfully completed with an overall response rate of 2.6 percent representing roughly 1,537 completed surveys.

Detailed characteristics of the drivers on the Spaulding Turnpike were drawn from the responses to the survey. Questions relating to travel frequency, trip purpose, vehicle occupancy, and potential mass transit ridership were asked. The results of the New Hampshire Seacoast Travel Survey are briefly discussed below. It is important to note that of those who responded to the survey, 75 percent were full or part-time residents of the New Hampshire Seacoast area. In addition, 53 percent of the trips described by the respondents included crossing the Little Bay Bridges.

Frequency of Travel

A total of 65 percent of the survey respondents stated that they traveled within the Seacoast Travel Survey area 4 or more times per week. Approximately 18 percent traveled within the survey area 1 to 3 times per week. The remaining 17 percent completed a Seacoast area trip less than 3 times per month.

Mode of Travel

Respondents were asked to define their primary mode of transportation when completing a Seacoast area trip. The majority, 78 percent, responded that they drove alone and 19 percent responded that they drove or rode with others. The remaining 3 percent rode a bus (2 percent, 27 responses) or biked, walked, or used some other means of transportation.

Trip Purpose

Work-related trips were reported as the primary trip purpose by the respondents at 73 percent. Other trip types (such as school, shopping, personal business, and recreation) make up the remaining 27 percent of the trip purposes.

Vehicle Occupancy

The majority (78 percent) of the respondents indicated that they made their respective trips alone. Of the 22 percent that traveled with passengers, 14 percent drove with 1 passenger, 5 percent drove with 2 passengers, and 3 percent drove with 3 or more passengers.

3.15.1.2 Vehicle Classification

The classification of vehicles by type (*i.e.,* passenger car, single unit truck, tractor-trailer, bus) is an important part of the data collection program, specifically for use in air quality and noise studies along the turnpike. Vehicle classification counts have been conducted by the NHDOT in 2002 at two locations along the Spaulding Turnpike – between Exits 1 and 2 and on the Little Bay Bridges. The counts show that approximately 55 percent of the daily, morning peak hour, and evening peak hour traffic volumes on the Spaulding Turnpike are passenger vehicles. Approximately 40 percent of the traffic is made up of pick-up trucks, sport utility vehicles (SUV), and light trucks such as delivery trucks or box trucks (2-axle long). The remaining 5 percent of the traffic consists of heavy trucks (2-axles 6 tire and larger) and buses.

■

3.15.2 Traffic Volumes

The purpose of this section is to establish and evaluate the existing traffic conditions within the study area. The following includes a discussion on traffic volume trends, the results of the existing conditions traffic operations evaluation, and the development of an appropriate design hour volume condition.

3.15.2.1 2003 Base Year Traffic Volumes

The NHDOT maintains a permanent traffic volume recorder station (24-hour operation) along the Spaulding Turnpike in Newington at the Little Bay Bridges (Station #331001). To supplement the data from this count station, temporary automatic traffic recorder counts or weekday AM and PM peak period manual traffic counts were conducted at each interchange (Exits 1 through 6). The majority of these supplemental counts were performed in May and June 2003. Hence, the weekday peak hour traffic volume networks and analyses presented herein for the 2003 Existing Conditions reflect the June condition. The 2003 weekday morning and evening peak hour traffic volumes at each of the study area intersections are presented in **Figures 3.15-1 and 3.15-2**.

Review of the peak hour and daily volumes recorded on the Little Bay Bridges in June 2003 reveal that the weekday morning peak hour volume (5,660 vehicles per hour) on the Spaulding Turnpike account for approximately 7 percent of the June weekday volume (78,650 vehicles per day) with roughly 70 percent traveling southbound and 30 percent northbound. The portion of daily traffic observed during the weekday evening peak hour volume (6,340 vehicles per hour) is slightly higher at approximately 8 percent with 65 percent traveling northbound and 35 percent traveling southbound.

3.15.2.2 Existing Traffic Operations

Measuring the volume of traffic along the Spaulding Turnpike indicates the importance of the corridor to the regional transportation system, but gives little indication of the quality of traffic flow. To assess the quality of traffic flow along the corridor and other study area roadways, capacity analyses were conducted to determine how well the Spaulding Turnpike serves the traffic demands placed upon it. The traffic performance measures and the evaluation criteria used in the operational analyses are based on the methodology in the *2000 Highway Capacity Manual*[18].

A primary result of the capacity analysis is the assignment of level of service (LOS)[19], which is a qualitative measure describing operational conditions within a traffic stream and their perception by a motorist or passenger. Level of service generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and, in doing so, provides an index to quality of traffic flow. Six levels of service are defined ranging in letter designation from LOS A to LOS F, with LOS A representing the best traffic operation and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak and design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustified. LOS E reflects traffic operations at capacity. The results of the freeway segment analysis are summarized in Table 3.15-1 and **Figures 3.15-3 and 3.15-4**. The figures also graphically show the freeway segments that experience capacity deficiencies during the 2003 weekday morning and evening peak hours, and the segments that currently have substandard geometric features, which are discussed in Section 3.15.4.

The freeway segment analysis results reveal poor operating conditions (LOS E or F) along the Spaulding Turnpike between Exits 3 and 6. During the 2003 AM peak hour, the corridor is at capacity (LOS E) in the southbound direction between Exits 6 and 3. During the 2003 PM peak hour, the corridor is at capacity in the northbound direction between Exits 4N and 6. In addition to the freeway segments being at or near capacity, capacity analyses for the four weave segments on the Spaulding Turnpike between Exits 4 and 6 (southbound at Exit 4 approaching Nimble Hill Road, southbound between Exits 4 and 4N, northbound between Exits 4N and 4, and northbound between Cote Drive and Exit 6N) indicate that all four weave areas operate at LOS E or F during either the 2003 weekday morning or evening peak hours.

▼

[18] 2000 Highway Capacity Manual, Transportation Research Board, Washington, D.C.

[19] Level of service (LOS) is a qualitative measure describing operational conditions within a traffic stream and their perception by a motorist or passenger. Level of service generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and, in doing so, provides an index to quality of traffic flow. Six levels of service are defined ranging in letter designation from LOS A to LOS F, with LOS A representing the best traffic operation and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak and design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustified. LOS E reflects traffic operations at capacity.

New Hampshire DOT
Department of Transportation

PEASE BLVD
EXIT 1
GOSLING RD
SPAULDING TURNPIKE
16
4
ARBORETUM DR
PEASE SPUR RR
EXIT 2
FOX RUN RD
40
WOODBURY AVE
EXIT 3
SPAULDING TURNPIKE
EXIT 4N
FOX POINT RD
NIMBLE HILL RD
EXIT 4
RIVER RD
SHATTUCK WAY
PATTERSON LN
GUILFORD RR NEWINGTON BRANCH

N

0 375 750 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-1
2003 Existing Conditions
AM Peak Hour - Weekday
Sheet 1 of 2

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New Hampshire DOT
Department of Transportation

0 375 750 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-1
2003 Existing Conditions
AM Peak Hour - Weekday
Sheet 2 of 2

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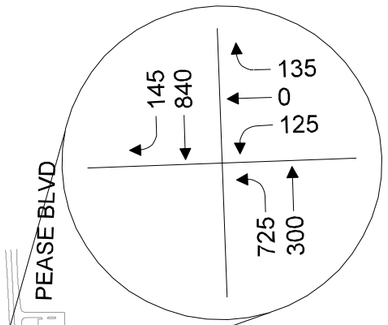
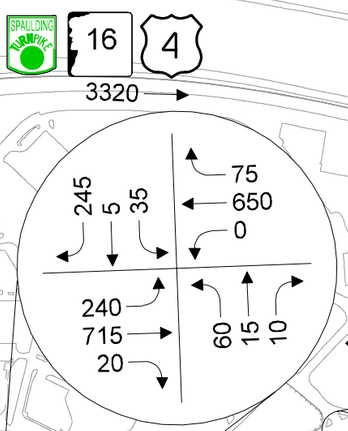
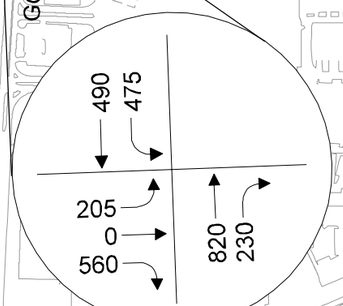
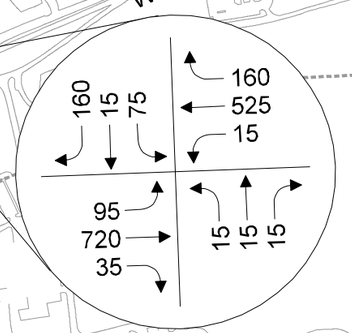
New Hampshire DOT
Department of Transportation

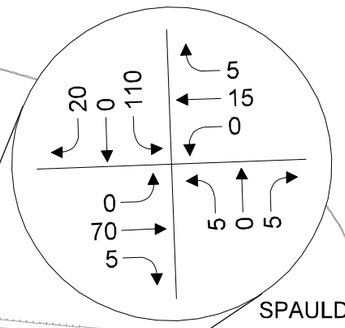
PEASE BLVD
GOSLING RD
FOX RUN RD
ARBORETUM DR
PEASE SPUR RR
FOX POINT RD
NIMBLE HILL RD
SPAULDING TURNPIKE
WOODBURY AVE
SHATTUCK WAY
PATTERSON LN
RIVER RD
GUILFORD RR NEWINGTON BRANCH
EXIT 1
EXIT 2
EXIT 3
EXIT 4N
EXIT 4

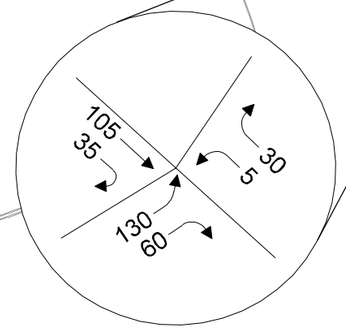


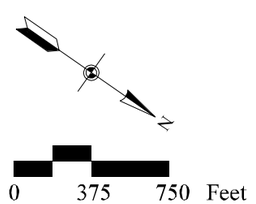












Vanasse Hangen Brustlin, Inc.

Figure 3.15-2
2003 Existing Conditions
PM Peak Hour - Weekday
Sheet 1 of 2

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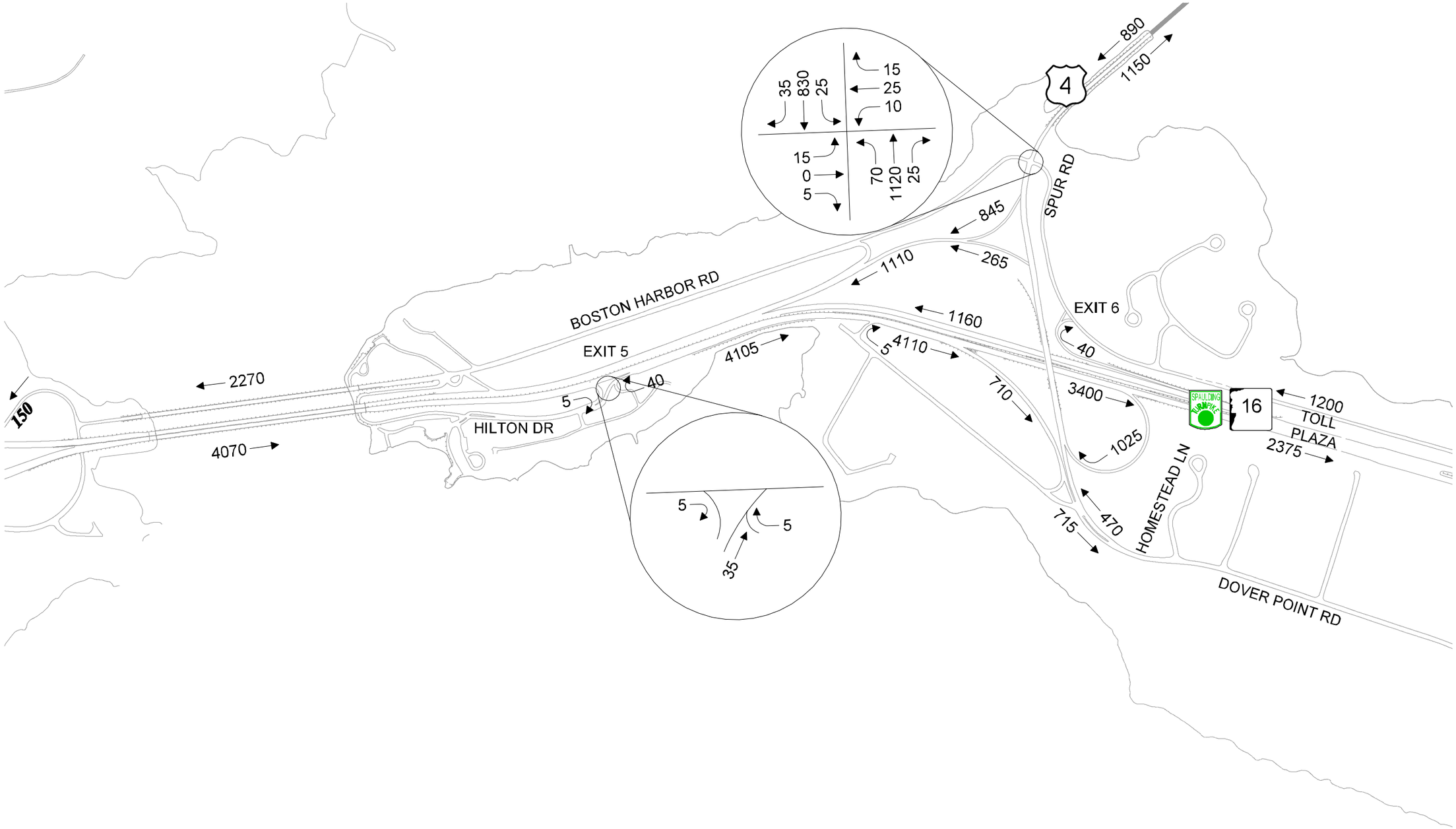
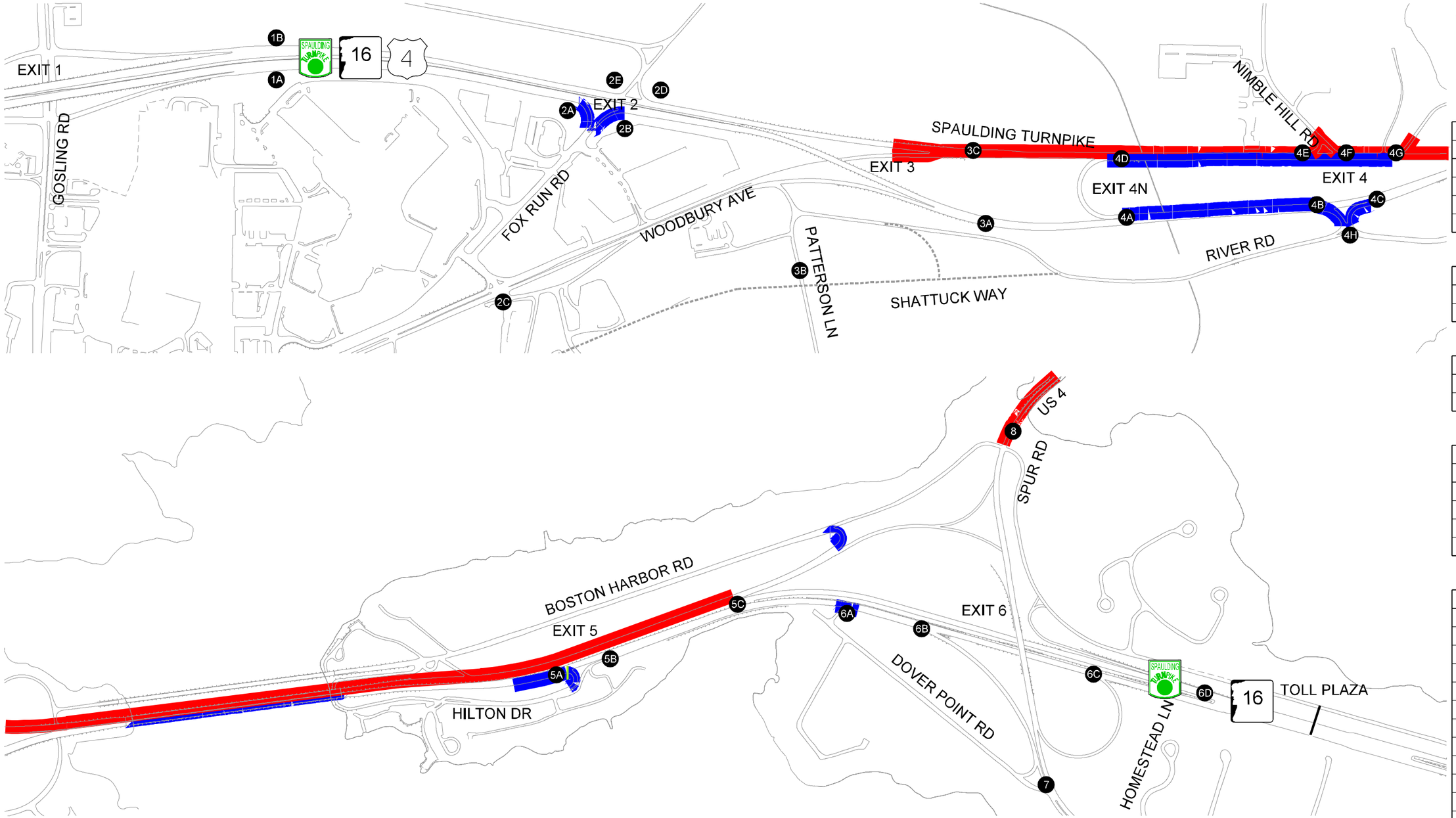
New Hampshire DOT
Department of Transportation



0 375 750 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-2
2003 Existing Conditions
PM Peak Hour - Weekday
Sheet 2 of 2



Legend:

CAPACITY DEFICIENCY

SUBSTANDARD GEOMETRICS

Freeway LOS

Node		2003 LOS
From	To	
Spaulding Turnpike NB		
1A	2A	B
2B	3A	B
4A	4B	C
4C	5A	B
5B	6A	B
6C	TOLL	A

Freeway LOS

Node		2003 LOS
From	To	
Spaulding Turnpike SB		
TOLL	6D	C
6D	5C	C
5C	4G	E
4E	3C	E
3C	2D	D
2E	1B	D

0 375 750 Feet

New Hampshire DOT
Department of Transportation

Arterial LOS

Node		2003 LOS
From	To	
2C	3C	D
3B	4H	A
7	NORTH	D
8	WEST	E

Signalized Intersection LOS

Node	2003 LOS
2C	B
8	C

Unsignalized Intersection LOS

Node	2003 LOS
3B	A
4H	B

Weave Analysis LOS

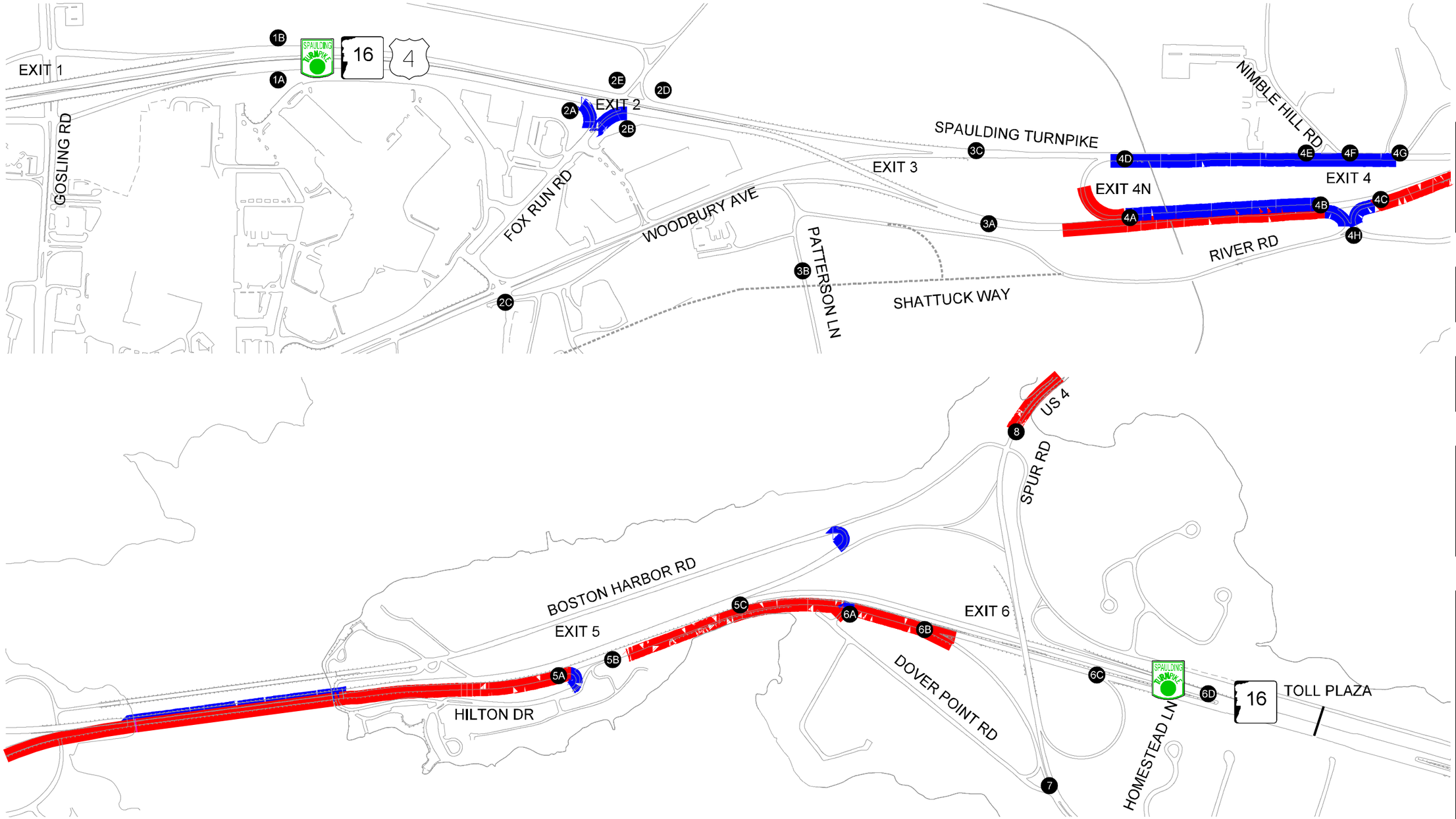
Node		2003 LOS
From	To	
4G	4F	E
4E	4D	F
4A	4B	B
6A	6B	B

Ramp Junction LOS

Node	2003 LOS
2A	B
2B	B
3A	B
3C	E
4A	B
4B	B
4C	B
4D	D
4E	E
4F	F
4G	F
5A	B
5B	B
6A	B
6B	B
6C	B
6D	B

Vanasse Hangen Brustlin, Inc.

Figure 3.15-3
Level of Service Summary
2003 Existing Conditions
AM Peak Hour - Weekday



Legend:

CAPACITY DEFICIENCY

SUBSTANDARD GEOMETRICS

Freeway LOS

Node		2003 LOS
From	To	
Spaulding Turnpike NB		
1A	2A	D
2B	3A	D
4A	4B	E
4C	5A	E
5B	6A	E
6C	TOLL	C

Freeway LOS

Node		2003 LOS
From	To	
Spaulding Turnpike SB		
TOLL	6D	B
6D	5C	B
5C	4G	C
4E	3C	C
3C	2D	B
2E	1B	B

0 375 750 Feet

New Hampshire DOT
Department of Transportation

Arterial LOS

Node		2003 LOS
From	To	
2C	3C	D
3B	4H	C
7	NORTH	D
8	WEST	E

Signalized Intersection LOS

Node	2003 LOS
2C	B
8	C

Unsignalized Intersection LOS

Node	2003 LOS
3B	B
4H	B

Weave Analysis LOS

Node		2003 LOS
From	To	
4G	4F	C
4E	4D	D
4A	4B	E
6A	6B	E

Ramp Junction LOS

Node	2003 LOS
2A	D
2B	C
3A	D
3C	C
4A	F
4B	D
4C	D
4D	C
4E	C
4F	C
4G	C
5A	D
5B	D
6A	E
6B	E
6C	D
6D	A

Vanasse Hangen Brustlin, Inc.

Figure 3.15-4
Level of Service Summary
2003 Existing Conditions
PM Peak Hour - Weekday

Table 3.15-1
2003 Existing Conditions Freeway Segment Analysis Summary

Segment	Weekday Period	Direction	Node to Node^	Volume	LOS
Exit 1 to Exit 2	AM Peak Hour	NB*	1A – 2A	1645	B
		SB**	2E – 1B	3055	D
	PM Peak Hour	NB	1A – 2A	3320	D
		SB	2E – 1B	1590	B
Exit 2 to Exit 3	AM Peak Hour	NB	2B – 3A	1495	B
		SB	4D – 3C	3880	E
	PM Peak Hour	NB	2B – 3A	3155	D
		SB	4D – 3C	2305	C
Exit 4N to Exit 4 NB	AM Peak Hour	NB	4A – 4B	1765	C
and		SB	4E – 4D	3975	E
Exit 4 to 3 SB	PM Peak Hour	NB	4A – 4B	4050	E
		SB	4E – 4D	2440	C
Exit 4 to Exit 5	AM Peak Hour	NB	4C – 5A	1635	B
(Little Bay Bridges)		SB	5C – 4G	4025	E
	PM Peak Hour	NB	4C – 5A	4070	E
		SB	5C – 4G	2270	C
Exit 5 to Exit 6N	AM Peak Hour	NB	5B – 6A	1665	B
		SB	6D – 5C	2505	C
	PM Peak Hour	NB	5B – 6A	4105	E
		SB	6D – 5C	1160	B
North of Exit 6W	AM Peak Hour	NB	6C – Toll	900	A
		SB	Toll – 6D	2530	C
	PM Peak Hour	NB	6C – Toll	2375	C
		SB	Toll – 6D	1200	B

LOS = Level of Service.
*NB = Northbound.
**SB = Southbound.
^ See **Figures 3.15-3 and 3.15-4**.

The breakdown in the 2003 peak hour traffic flow and congestion associated with the main line capacity between Exits 3 and 6 also extends to interchange traffic operations, as summarized in Table 3.15-2.

As shown in the table, LOS E or F conditions exist during the 2003 AM peak hour at the Exit 3 southbound off ramp, the Nimble Hill Road southbound on and off ramps, and the River Road southbound on ramp. During the 2003 PM peak hour, interchange breakdowns (LOS E or F) occur at the Exit 4N northbound on ramp, Exit 6 northbound on ramp, and Exit 6N northbound off ramp.

Table 3.15-2
2003 Existing Conditions
Ramp Junctions Analysis Summary

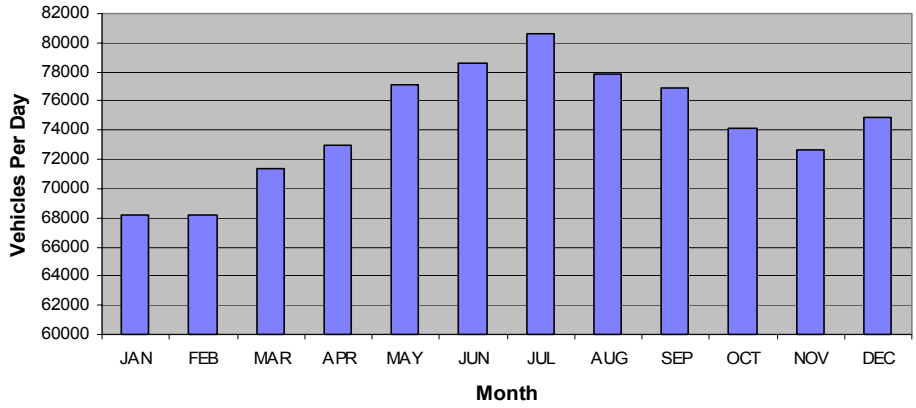
Interchange Movement	Node^	Weekday Time Period	LOS
Exit 2			
NB off ramp	2A	AM Peak Hour	B
NB on ramp	2B		B
NB off ramp	2A	PM Peak Hour	D
NB on ramp	2B		C
Exit 3			
NB on ramp	3A	AM Peak Hour	B
SB off ramp	3C		E
NB on ramp	3A	PM Peak Hour	D
SB off ramp	3C		C
Exit 4			
NB 4N on ramp	4A	AM Peak Hour	B
NB 4 off ramp	4B		B
SB 4N off ramp	4D		D
SB Nimble Hill Rd on ramp	4E		E
SB Nimble Hill Rd off ramp	4F		F
SB River Road on ramp	4G		F
NB 4N on ramp	4A	PM Peak Hour	F
NB 4 off ramp	4B		D
SB 4N off ramp	4D		C
SB Nimble Hill Rd on ramp	4E		C
SB Nimble Hill Rd off ramp	4F		C
SB River Road on ramp	4G		C
Exit 5			
NB on ramp	5B	AM Peak Hour	B
NB off ramp	5A		B
NB on ramp	5B	PM Peak Hour	D
NB off ramp	5A		D
Exit 6			
NB on ramp	6A	AM Peak Hour	B
NB 6N off ramp	6B		B
NB 6W off ramp	6C		B
SB Spur Rd off ramp	6D		B
NB on ramp	6A	PM Peak Hour	E
NB 6N off ramp	6B		E
NB 6W off ramp	6C		D
SB Spur Rd off ramp	6D		A

LOS – Level of Service
^ See **Figures 3.15-3 and 3.15-4**.

3.15.2.3 Seasonal Variation and Growth Trends

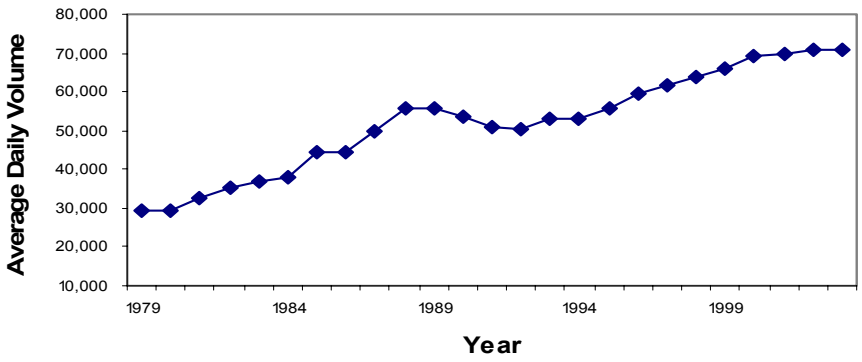
Examination of the monthly variation in the 2003 average weekday traffic on the Little Bay Bridges shows July as the peak month with an ADT of 80,600 vehicles per day. The months of June and August have the next highest volumes, being roughly 3 percent lower than July. The monthly variation in the average weekday traffic observed on the Little Bay Bridges in 2003 is shown graphically in **Figure 3.15-5**.

Figure 3.15-5
Monthly Variations
Spaulding Turnpike at Little Bay Bridges
2003 Average Weekday Volume



In addition to reviewing seasonal trends, historical traffic growth trends were also examined. The NHDOT permanent traffic recorder count station on the Little Bay Bridges provided historical traffic volume data from 1979 to 2003. During this time period the annualized average daily traffic (AADT) grew from 29,500 to 70,650 vehicles per day. The growth in AADT is depicted in **Figure 3.15-6**. The AADT over the 24-year period revealed an average annual growth rate of approximately 3.7

Figure 3.15-6
Spaulding Turnpike at Little Bay Bridges
Average Annual Daily Traffic Growth



percent. More recently, the annual rate of traffic growth has decreased. During the 1993 to 2003 ten-year period, traffic increased annually at an average growth rate of approximately 2.9 percent. Since 1998, traffic has increased at an average annual rate of approximately 2.1 percent per year.

3.15.2.4 Design Hourly Volumes

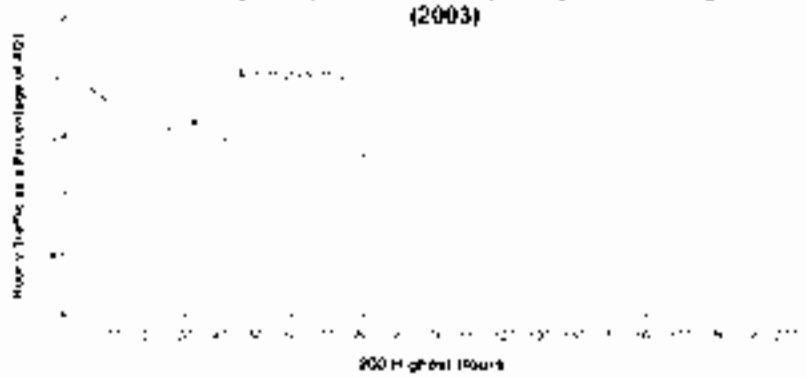
The general unit of measure used to quantify roadway usage is average daily traffic (ADT), which is defined as the total volume of traffic during a given period of time divided by the number of days in that time period. A more specific unit of measure is known as the average annual daily traffic volume (AADT), which is determined by dividing the total yearly volume by the number of days in the year. Although an actual AADT can only be established at a continuous count station, AADT's can be estimated along roadway segments by applying factors developed from data collected at continuous count stations to specific daily or hourly counts.

While the AADT's are an important measure, it is the hourly volume that is primarily used to evaluate and design roadway facilities. However, because hourly volumes can vary substantially over the course of the day and throughout the year, it is necessary to select an appropriate design hourly volume condition. It would be uneconomical to predicate a design on the (maximum) peak hour traffic volume of the year, yet the use of the average hourly traffic would result in an inadequate design. The hourly traffic volume used for the purpose of determining the basic lane requirements on the highway facility should not be exceeded very often or by very much. On the other hand, it should not be so high that the volume of traffic would rarely be high enough to make full use of the facility.

Therefore, the most appropriate procedure to determine basic lane requirements on the Spaulding Turnpike is to establish a 30th highest volume (design condition), as described in *A Policy on Geometric Design of Highways and Streets*[20]. Given economic considerations involved in the planning and design of roadway facilities, this design criteria is selected since the 30th highest hourly volume generally reflects a "point of diminishing return" in that a substantial increase in design requirements would accommodate only very few periods of higher traffic volumes. This condition is reflected for the Turnpike in the curve, as shown in **Figure 3.15-7**, which tends to steepen quickly to the left of the 30th highest hour indicating much higher traffic volumes for the inclusion of only a few more of the higher hourly volumes while the curve flattens to the right indicating many hours in which the volume is not much lower than the 30th highest hour.

[20] American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

Figure 3.15-7
Peak Hour to ADT Relationship
Spaulding Turnpike at Little Bay Bridges in Newington
(2003)



Based on the 2003 data provided at the NHDOT permanent count station location on the Little Bay Bridges, the 30th highest hour volume is approximately 9.55 percent of the ADT. The Directional Design Hour Volume (DDHV) split is approximately 62 percent of the total hourly traffic traveling in the peak direction.

The 2003 data from the permanent count station on the Little Bay Bridges was used to establish base year 2003 average annual daily traffic (AADT) volumes, DHV's, and DDHV's for each segment of the Spaulding Turnpike. Table 3.15-3 shows that the 2003 AADT's along the Spaulding Turnpike range from a low of 39,850 vehicles per day north of Exit 6 to a high of 71,050 vehicles per day between Exits 5 and 6. The DHV ranges from approximately 3,800 to 6,500 vehicles per hour and the DDHV ranges from approximately 2,400 to 4,200 vehicles per hour.

Table 3.15-3
2003 Design Hourly Traffic Volumes

Spaulding Turnpike Segment	AADT*	DHV**	DDHV***
Between Exits 1 and 2	54,700	5,200	3,200
Between Exits 2 and 3	52,950	5,100	3,200
Between Exits 3 and 4	69,300	6,600	4,100
Between Exits 4 and 5 (Little Bay Bridges)	70,650	6,700	4,200
Between Exits 5 and 6	71,050	6,800	4,200
North of Exit 6	39,850	3,800	2,400

*AADT = Average Annual Daily Traffic (vehicles per day)
**DHV = Design Hourly Volume (9.55% of AADT rounded to nearest 100 vehicles)
***DDHV = Directional Design Hour Volume (62% of DHV rounded to nearest 100 vehicles)

Comparing the 2003 DDHV's to the June 2003 peak hour traffic volumes noted in **Figures 3.15-1 and 3.15-2** (as well as in Table 3.15-1) indicates that the peak directional volumes are quite similar. It can therefore be said that the June data evaluated under the existing conditions approximate the 30th highest hour for analysis purposes.

The design year condition for developing improvements to the Spaulding Turnpike is 2025. DHV and DDHV traffic conditions for the Turnpike will be developed for 2025 based on traffic projections provided by the Seacoast Metropolitan Planning Organization's (MPO) Travel Demand Model (Section 3.15.2.5). The DHV and DDHV will be used to determine the basic lane requirements for study area segments of the Turnpike. The 2025 weekday AM and PM peak hour volume projections by the Seacoast MPO Travel Demand Model will be used for the purpose of evaluating traffic operations at the study area interchanges and intersections, ramps, weaves, and arterials.

3.15.2.5 Traffic Forecasting

The purpose of this section is to describe the methodology used to forecast the traffic volume projections for the study area roadways and intersections. Specifically, this section describes the development of the Seacoast Regional Travel Demand Model (herein referred to as the "Model"), which serves as the basis for the projected 2025 traffic volumes being used for this project. 2005 traffic projections are also being developed to assess short term, low-cost transportation system management (TSM) alternatives to improve traffic operations efficiency and increase safety. (More detailed information on the Model development can be found in the report titled Documentation of the Seacoast Regional Travel Demand Model prepared by Resource Systems Group, Inc.) In addition to forecasting future year traffic volumes, the Model is the tool that will be used to evaluate potential new or improved transportation services and strategies, in an effort to improve overall transportation services in the study area and reduce congestion on the Spaulding Turnpike.

The Model is an integrated set of travel demand and land use models that help predict travel behavior (*i.e.*, how people travel by car, bus, etc.) and travel demand (*i.e.*, how many people want to travel on a certain road or by a certain mode) within the Seacoast MPO region. The MPO region consists of Strafford County, Rockingham County, and portions of northern Massachusetts. For the purposes of the model's development, the MPO region was broken down into 354 Transportation Analysis Zones (TAZ's) with 32 external stations for traffic to enter and exit the model area. System-wide data on roadways, bus services, rail systems, land use, and social and economic characteristics within the region were collected to establish the existing base model condition. In addition, the New Hampshire Seacoast Travel Survey (discussed in Section 3.15.1.1) conducted in June 2003 provided an up-to-date

source of information on existing passenger vehicle and transit ridership characteristics within the Newington-Dover project study area.

The Model has been developed using TransCAD, which is a geographic information system (GIS) based software package. In general, the modeling process consists of four steps: trip generation, trip distribution, mode split, and trip assignment. The trip generation and distribution modules translate land use activity within the TAZ's into trips. The mode split module selects the mode of travel for each trip (*e.g.*, auto, carpool, bus, walk, and bike). Vehicle and transit trips are then assigned to the highway networks through the assignment module.

The Model has been calibrated to represent the year 2000 weekday morning and weekday evening peak hour conditions. Calibration is considered complete when the computer-generated volumes reasonably represent actual ground counts. Ground counts from approximately 6 percent of the roadway links in the Model (339 counts out of 5,883 one-way links) were used in the calibration process. Calibration standards[21] published by the Federal Highway Administration (FHWA) provide guidance in determining if a model is within acceptable limits of error. **Table 3.15-4** compares the FHWA guidelines and the calibrated AM and PM peak hour models. As shown, both the AM and PM peak hour model volumes meet or exceed the FHWA guidelines. Therefore, it was determined that the 2000 Model accurately reflects the actual traffic volume conditions within the study area and could be used for planning and forecasting purposes.

Table 3.15-4
Model Calibration

		Percent Error Compared to Ground Counts	
Type of Roadway	FHWA Limit of Error	AM Model	PM Model
Freeways	7%	3%	1%
Principal Arterials	10%	8%	9%
Minor Arterials	15%	-15%	-5%
Collector Streets	25%	8%	-21%
Region-Wide	5%	-4%	-1%

[21] Calibration and Adjustment of System Models, Federal Highway Administration, December 1990.

From the calibrated Model, traffic forecasts were made for the years 2005 and 2025. Future growth and land use assumptions (including housing, employment, and population) for the 2005 and 2025 scenarios were developed by the Seacoast MPO. In addition, the future year highway network was modified to include planned transportation improvements that are included in the state's most recent draft Ten Year Transportation Plan and expected to occur by 2005 and 2025 respectively. A sample of these improvement projects within the MPO region include the Spaulding Turnpike Exit 4 interim safety improvements, Spaulding Turnpike construction of Exit 10 and easterly connection, US Route 1 Bypass reconstruction in Portsmouth, I-93 widening from the Massachusetts State Line to I-293, and NH Route 111 Bypass construction in Windham and Salem.

Table 3.15-5 compares the existing 2003 traffic volumes to the projected 2025 travel demand. As shown, the 2025 AADT for the Spaulding Turnpike ranges from a low of approximately 57,500 vpd north of Exit 6 to a high of approximately 102,200 vpd between Exits 5 and 6. Within the study area, the DHV ranges from approximately 7,300 vph to 9,800 vph, and the DDHV ranges from approximately 4,500 vph to approximately 6,100 vph. These volumes exceed the existing peak hour capacity of the Turnpike. Without improvements to the Turnpike or substantial changes in the current mode choice of motorists (*e.g.*, car pooling or transit versus single occupancy vehicles), congestion levels will spread beyond the typical commuter peak hours and will encompass more hours of the day. Travel demand increases from 2003 to 2025 are expected to range from approximately 41 to 45 percent.

Table 3.15-5
2003 and 2025 Average Daily and Design Hour Volumes

	2003			2025		
Turnpike Segment	**AADT***	**DHV****	**DDHV*****	**AADT***	**DHV****	**DDHV*****
Between Exits 1 and 2	54,700	5,200	3,200	77,400	7,400	4,600
Between Exits 2 and 3	52,900	5,100	3,200	76,200	7,300	4,500
Between Exits 3 and 4	69,300	6,600	4,100	96,900	9,300	5,800
Between Exits 4 and 5 (Little Bay Bridges)	70,650	6,700	4,200	101,800	9,700	6,000
Between Exits 5 and 6	71,050	6,800	4,200	102,200	9,800	6,100
North of Exit 6	39,850	3,800	2,400	57,500	5,500	3,400

* AADT – Average Annual Daily Traffic expressed in vehicles per day.
** DHV - Design Hour Volume expressed in vehicles per hour.
*** DDHV - Directional Design Hour Volume expressed in vehicles per hour.

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3.15.3 Accident Statistics

Accident statistics compiled by the NHDOT are based on information provided by the New Hampshire Department of Safety (NHDOS) and may not include minor accidents that are unreported. For the purpose of this study, accident records were obtained from the NHDOT, as well as the Dover, Newington, and Portsmouth Police Departments.

Statistics for the five-year period of January 1992 through December 1996 were previously reported in the Spaulding Turnpike Improvements Feasibility Study (February 2000). That study reported a total of 575 accidents within the study area from 1992 through 1996. To supplement the older data, the most recent five-year period of available accident data, January 1997 through December 2001, was compiled and reviewed. The updated information shows a substantial increase in the number accidents with 908 accidents reported within the study area from 1997 through 2001. This represents a 58 percent increase over the previous five-years. Table 3.15-6 provides a summary of the 1997 through 2001 accident data.

While caution should be applied when attempting to relate accident trends to potential causation, the following trends (1997 – 2001) have been identified:

- The number of accidents within the study area has steadily increased at an average rate of 11 percent per year from 1997 through 2001 beginning with 144 accidents in 1997 and ending with 220 accidents in 2001. During this same time period, traffic volumes along the Spaulding Turnpike increased on average by approximately three percent per year. The fact that accidents are occurring at nearly four times the rate of traffic growth suggests a deterioration of safety along the corridor.

- The highest number of accidents reported on the Spaulding Turnpike occurred on the Little Bay Bridges where 97 accidents occurred from 1997 through 2001. During the years 1997, 1998, and 1999, approximately 15 accidents per year occurred on the bridges. This number increased substantially to 24 and 28 accidents per year respectively, in 2000 and 2001. Other segments of the Turnpike experienced much lower accident rates ranging between 5 and 25 accidents over the five year analysis period.

- The number of accidents that occurred at each of the interchanges range from a low of 15 accidents at Exit 5 over the five-year period to 82 accidents at Exit 1.

- There were no reported fatalities.

Table 3-15-6
Accident Summary (January 1997 – December 2001)

LOCATION		Spaulding Tpk Exit 1 / Gosling Rd	Spaulding Tpk Exit 1 NB / Gosling Rd	Spaulding Tpk Exit 1 SB / Gosling Rd	Between Exits 1 - 2	Spaulding Tpk Exit 2 / Fox Run Rd	Spaulding Tpk Exit 2 NB / Fox Run Rd	Spaulding Tpk Exit 2 SB / Fox Run Rd	Between Exits 2 - 3	Spaulding Tpk Exit 3 / Woodbury Ave	Spaulding Tpk Exit 3 NB / Woodbury Ave	Spaulding Tpk Exit 3 SB / Woodbury Ave	Between Exits 3 - 4	Spaulding Tpk Exit 4	Spaulding Tpk Exit 4N Turnaround	Spaulding Tpk Exit 4 / Nimble Hill Rd	Spaulding Tpk Exit 4 / River Rd	Spaulding Tpk Exit 4S Turnaround	Between Exit 4 - Bridge	Spaulding Tpk on Little Bay Bridge	Between Bridge - Exit 5	Spaulding Tpk Exit 5	Spaulding Tpk Exit 5 / Hilton Dr	Spaulding Tpk Exit 5 / Wentworth Ter	Between Exits 5 - 6	Spaulding Tpk Exit 6	Spaulding Tpk Exit 6N / Dover Pt Rd	Spaulding Tpk Exit 6W / Rt 4	Spaulding Tpk Exit 6 / Spur Rd	Between Exit 6 - Toll	Woodbury Ave / Gosling Rd	Woodbury Ave / Fox Run Rd	Woodbury Ave / River Rd	Gosling Rd / Industrial Access Rd	River Rd / Patterson Ln	River Rd / Industrial Access Rd	Dover Point Rd / Cote St	Rt 4 / Boston Hr Rd / Spur Rd / Dover Pt Rd	Along Spaulding Tpk (Dover)	Along Spaulding Tpk (Newington)	Along Woodbury Ave (Newington)	Along Gosling Rd	Along Fox Run Rd	Along River Rd	Along Nimble Hill Rd (STpk - Fox Point Rd)	Along Dover Point Rd (s/o Pineview Dr)	Along Boston Harbor Rd	Along Cote Dr	Along Route 4 (Dover)	Along Spur Rd	TOTAL	PERCENT
YEAR																																																				
1997		9	4		4	1	1		1	6		1	3	7	1	4	1		5	11	3				1	3	3	4		3	15	2						2	1	6	19	6	2		2	2	2		9		144	16%
1998		10			1	2	1			2		1	1	5	1		2		1	19	5	2		1			5	13		4	17							2		7	20	16		1	1	3	1		12		156	17%
1999		16	1	3	1	3			1	2		1	8	9	1	3	1		4	15	3	4			3	1	5	5		4	18	2	1					12		8	14	18	3	1		1	1		12	2	187	21%
2000		11	7	3	3	4			3	2		2	8	5	5	5	1	1	5	24	7	2		1		4	2	1		3	24		2					6		7	23	14	1	1		5		1	8		201	22%
2001		9	6	3	2	4	4			2			3	9	7	1	2	3	5	28	7	5			2	2	1	3		3	22	2						6		15	25	19	3	4		4			9		220	24%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%
TYPE																																																			
Angle		2													1					1										4							3				9				1				21	2%
Rear-End		8	3	2	2	6	2		1	3			5	8	4	3	4	1	3	36	11	1				2	4	4		2	13	1	1					12		13	6	6			6	2		26		201	22%
Head-on																															1										1						1	1		4	0%
Sideswipe		1		1									1		2			1		2		1						1		1	1							1												13	1%
Fixed Object																																																		0	0%
Other/Unknown		44	15	6	9	8	4		4	11		5	17	27	9	9	3	2	17	59	13	11		2	6	8	12	21		14	77	5	2					12	1	30	95	57	9	7	3	9	1		23	2	669	74%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%
SEVERITY																																																			
Property Damage		4			2	2				4			1	2	2	1	1		1	8	2	1					2				11	2	1					11		6	5	3	1		2			14	2	91	10%
Personal Injury		12	5	2	3	2	2		1	3		1	4	6	1	1	3	1	8	21	2	3			2	4	4	7		2	24		1					7		5	28	19	4	2		6	1		10		207	23%
Pedestrian Injury																				1	1										1																				3	0%
Fatality																																																		0	0%
Unknown/None		39	13	7	6	10	4		4	7		4	18	27	12	11	3	3	11	67	20	9		2	4	6	10	19		15	60	4	1					10	1	32	68	51	4	5	3	7	3	1	26		607	67%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%
DAY OF WEEK																																																			
Mon-Fri		44	14	7	10	12	2		5	11		5	19	31	11	8	7	4	19	83	21	11		1	6	9	11	25		11	72	5	2					18	1	38	66	62	5	4	3	8	2	1	32	2	708	78%
Sat-Sun		11	4	2	1	2	4			3			4	4	4	5			1	14	4	2		1		1	5	1		6	24	1	1					10		5	35	11	4	3		7	2		18		200	22%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%

Table 3-15-6 (continued)

LOCATION		Spaulding Tpk Exit 1 / Gosling Rd	Spaulding Tpk Exit 1 NB / Gosling Rd	Spaulding Tpk Exit 1 SB / Gosling Rd	Between Exits 1 - 2	Spaulding Tpk Exit 2 / Fox Run Rd	Spaulding Tpk Exit 2 NB / Fox Run Rd	Spaulding Tpk Exit 2 SB / Fox Run Rd	Between Exits 2 - 3	Spaulding Tpk Exit 3 / Woodbury Ave	Spaulding Tpk Exit 3 NB / Woodbury Ave	Spaulding Tpk Exit 3 SB / Woodbury Ave	Between Exits 3 - 4	Spaulding Tpk Exit 4	Spaulding Tpk Exit 4N Turnaround	Spaulding Tpk Exit 4 / Nimble Hill Rd	Spaulding Tpk Exit 4 / River Rd	Spaulding Tpk Exit 4S Turnaround	Between Exit 4 - Bridge	Spaulding Tpk on Little Bay Bridge	Between Bridge - Exit 5	Spaulding Tpk Exit 5	Spaulding Tpk Exit 5 / Hilton Dr	Spaulding Tpk Exit 5 / Wentworth Ter	Between Exits 5 - 6	Spaulding Tpk Exit 6	Spaulding Tpk Exit 6N / Dover Pt Rd	Spaulding Tpk Exit 6W / Rt 4	Spaulding Tpk Exit 6 / Spur Rd	Between Exit 6 - Toll	Woodbury Ave / Gosling Rd	Woodbury Ave / Fox Run Rd	Woodbury Ave / River Rd	Gosling Rd / Industrial Access Rd	River Rd / Patterson Ln	River Rd / Industrial Access Rd	Dover Point Rd / Cote St	Rt 4 / Boston Hr Rd / Spur Rd / Dover Pt Rd	Along Spaulding Tpk (Dover)	Along Spaulding Tpk (Newington)	Along Woodbury Ave (Newington)	Along Gosling Rd	Along Fox Run Rd	Along River Rd	Along Nimble Hill Rd (STpk - Fox Point Rd)	Along Dover Point Rd (s/o Pineview Dr)	Along Boston Harbor Rd	Along Cote Dr	Along Route 4 (Dover)	Along Spur Rd	TOTAL	PERCENT
SURFACE CONDITION																																																			
Dry		31	13	4	10	11	5		3	12		4	21	29	10	9	7	3	16	72	15	8			4	10	13	23		10	68	4	2					23		33	78	50	6	5	2	11	3	1	38	2	669	74%
Wet		11	4	2		3	1		2	1			2	3	5	2		1	2	13	5	3		1	1		2	2		5	25	1						5	1	5	16	18	1	2		3	1		9		158	17%
Snow/Ice		10	1	3	1							1		3		1			2	11	5	2		1	1		1	1		2	2	1								2	5	4	1		1	1					63	7%
Other/Unknown		3								1						1				1											1		1							3	2	1	1						3		18	2%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%
WEATHER																																																				
Clear/Cloudy		38	13	4	10	11	5		2	12		4	21	31	11	11	7	4	18	75	15	9			4	10	14	24		12	80	4	2					23		34	86	56	9	6	3	12	3	1	42	2	728	80%
Rain		6	2	2		3	1		1	1			2	2	4	1				12	5	2		1	2		1	1		3	13	1	1					4	1	5	12	12		1		2	1		6		111	12%
Snow/Ice		9	2	3	1							1		2					2	10	5	2		1			1	1		2	2	1								2	2	3				1					53	6%
Other/Unknown		2	1						2	1						1															1							1		2	1	2							2		16	2%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%
SEASON																																																			
Winter (Dec-Feb)		19	5	4	2	2	1		1	2		2	2	13	4	2	1		6	17	7	2			2	1	3	5		4	29	2						1		14	19	26	5		1	3			9		216	24%
Spring (Mar-May)		15	5	2	1	4	1		2	3		1	3	9	2	5	1	1	5	21	10	5		1	2	2	6	6		2	26	1	1					13	1	7	33	17		2		3	1		8		228	25%
Summer (Jun-Aug)		12	4		5	7	2		2	4			12	7	7	4	3	1	7	25	4	1		1	1	3	3	9		6	19	1	1					7		7	22	18	2	1	2	4	2		14	2	232	26%
Fall (Sept-Nov)		9	4	3	3	1	2			5		2	6	6	2	2	2	2	2	34	4	5			1	4	4	6		5	22	2	1					7		15	27	12	2	4		5	1	1	19		232	26%
Total		55	18	9	11	14	6	0	5	14	0	5	23	35	15	13	7	4	20	97	25	13	0	2	6	10	16	26	0	17	96	6	3	0	0	0	0	28	1	43	101	73	9	7	3	15	4	1	50	2	908	100%

Source: New Hampshire Department of Transportation, Dover Police Department, Newington Police Department, and Portsmouth Police Department

- Accident frequency is equally distributed among the four seasons of the year.

- The road surface condition was reported as dry for 669 accidents (74 percent), wet for 158 accidents (17 percent), and snow or ice for 63 accidents (7 percent). The road conditions for the 18 remaining accidents (2 percent) are unknown.

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3.15.4 Geometric Deficiencies

Existing geometric deficiencies within the project limits were identified by comparing the existing horizontal and vertical geometry with the desirable design criteria found in the 2001 AASHTO *Policy on Geometric Design of Highways and Streets,* and based on the NHDOT design standards for the applicable classifications of roadway.

The NHDOT provided Functional Classifications for the roadways within the study area, as shown in **Figure 3.15-8**. These classifications are useful in determining the applicable design standards for each roadway. The Spaulding Turnpike falls under the functional classification of Principal Arterial (other Urban Freeways and Expressways). Within the project limits the Spaulding Turnpike classification is influenced by the close spacing of interchanges, the density of the surrounding roadway network, and the surrounding industry, population centers and land use.

The roadways that access the Spaulding Turnpike at the five interchanges within the project limits vary in classification. These range from Nimble Hill Road, a local roadway at Exit 4, to US Route 4 which is classified as "Other (urban) Principal Arterial" at Exit 6. As a result of this range of classifications, there is also a range of design criteria for evaluating the deficiencies of each roadway.

Four roadway classifications were identified for use in identifying existing geometric deficiencies. These four classifications, and their corresponding design criteria, are listed in Table 3.15-7.

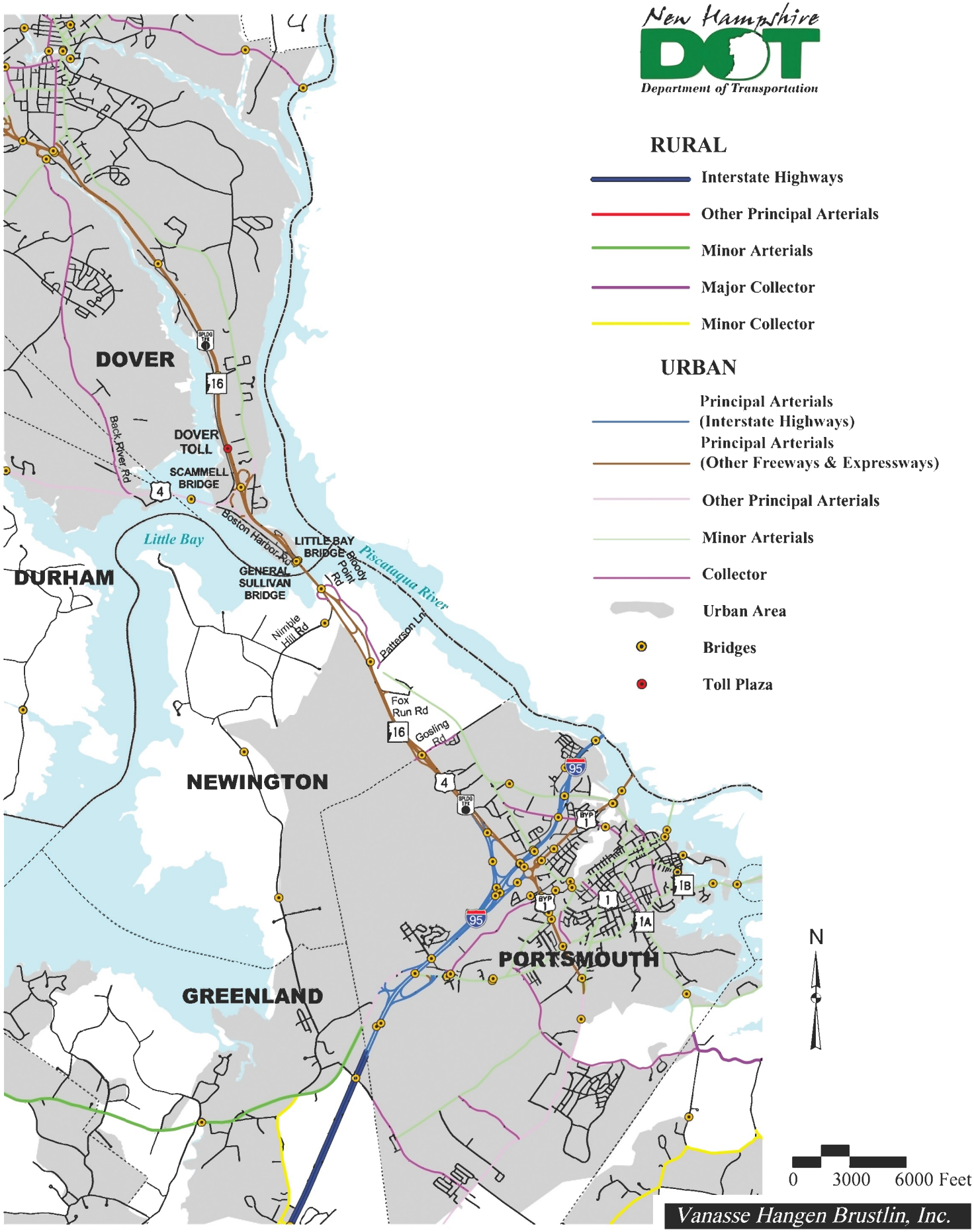


Figure 3.15-8
Functional Classification Map

Table 3.15-7
Roadway Design Criteria for Evaluation of Existing Roadway Deficiencies

	Local Roads	Collectors	Minor Arterials	Principal Arterials (Other)	Ramps	Principal Arterials (Freeway)
Rural / Urban:		Urban	Urban	Urban		Urban
Project Roadways:	Fox Run Road Patterson Lane Nimble Hill Road Boston Harbor Road Spur Road	Gosling Road River Road River Road Ext	Woodbury Ave Dover Point Road	US Route 4		Spaulding Trnpk
Design Speed	30 – 50 mph	30 – 50 mph	40 – 50 mph	50 – 60 mph	50 mph at nose 30 mph on ramp	60 mph
Maximum Grade:	8%	8%	5% desirable	4% desirable	6% - 8%	4% desirable
Minimum Grade:	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Minimum Radius:	300'	300'	565'	930'	275'	1,505'
Lane Width:	11' to 12'	11' to 12'	12'	12'	* 20' – 28'	12'
Shoulder Width:	2' to 6'	4' to 6'	4' to 6'	6' to 10'	*	10' to 12'
Access Control:	None	None	Desired	Desired	Required	Required

Structures Criteria

Minimum Vertical Clearances:	
Over Major Roadways:	16'-6"
Over Minor Roadways:	14'-6"
Over Railroads:	22'-6"
Minimum Grade on Bridge:	1%

* 20-foot curb-to-curb width or 28-foot uncurbed width on ramps.

The following is a summary of the existing geometric deficiencies, listed south to north, according to the AASHTO Guidelines and NHDOT Design Standards.

3.15.4.1 Spaulding Turnpike Mainline

The existing horizontal and vertical mainline alignments support the freeway design speed of 60 mph. On existing facilities, the design speed is the maximum safe traveling speed that can be maintained on the highway based on the existing horizontal and vertical geometrics. On new facilities, the selection of a design speed should also be based on the highway classification, the terrain, the level of congestion and potential future improvements to adjacent roadway segments. The selected design speed then dictates the allowable minimum design criteria for the particular highway classification. The design speed is not the same as the posted speed limit. The posted speed limit is generally set 5 to 10 mph below the design speed. The operating speed is the speed that is normally observed on the facility and it is generally higher than the posted speed limit.

The mainline lanes are 12 feet wide, and the shoulders vary in width throughout the corridor. The outside shoulders are generally 10 feet wide with the exception of the approaches to the Little Bay Bridges where the shoulders taper down to meet the deficient 2-foot shoulders on the bridges. The inside shoulders narrow from 10 down to 4 feet wide from Exit 2 to Exit 4N. North of the Little Bay Bridges the inside shoulders are 5 feet wide measured from travel lane to face of concrete barrier. The inside shoulders reduce to 4 feet wide from the north end of the median barrier to the end of the grass median between Exit 6 and the Dover Toll Plaza.

The shoulder widths and vertical alignment of the Little Bay Bridges are discussed later in this section.

3.15.4.2 Interchanges

Exit 2 - Fox Run Road

Consists of a northbound right-in /right-out ramp system to Fox Run Road. The right-in /right-out southbound ramps served the former Pease Air Force Base, but are currently closed to traffic.

NB Off Ramp

- 20 mph 150-foot radius off ramp (300′ radius desired for 30 mph) in combination with the substandard 400-foot long parallel deceleration lane (440′ length desired for 55 mph mainline speed).

- Close proximity of major commercial drive near the end of the off ramp. This introduces potential safety concerns due to stopped and turning vehicles at the end of the ramp.

NB On Ramp

- 28 mph (230′ radius) ramp and 400-foot (700-foot desired) acceleration lane prior to the 50:1 merge.

Exit 3 – Woodbury Avenue

Consists of a high speed connection from Woodbury Avenue onto the northbound Turnpike, and a high speed left-hand exit from the Southbound Turnpike to Woodbury Avenue.

NB On Ramp

- There are no geometric deficiencies with this on-ramp.

SB Off Ramp

- The left-hand off-ramp is uncommon and unexpected by drivers unfamiliar with the area. Left-hand off-ramps are discouraged in the national guidelines, particularly where there are right lane off-ramps in the area, as is the case in Newington.

- The left-hand off-ramp is formed with a 25:1 taper. A longer taper, or even the formation of a parallel off-ramp lane would be more desirable since this is a major diverge location.

Exit 4N

Consists of a southbound-to-northbound reverse direction loop ramp in the median between the two sides of the Turnpike.

- The turn radius is only 210 feet, supporting approximately 27 mph, however the parallel deceleration lane length of 570 feet is more than adequate (400 feet desirable).

- Total acceleration, deceleration and weave distance of approximately 1,500 feet between Nimble Hill Road (Exit 4) and Exit 4N is deficient (approximately 2,800 feet required). The mirror image exists on the northbound side between Exit 4N and the Exit 4 off-ramp to River Road.

- The short weaves involving the high speed lanes introduce operational and safety concerns due to vehicles changing lanes within a short distance and mixing with higher speed through vehicles.

Exit 4 – SB at Nimble Hill Road

Consists of a southbound right-in/right-out ramp system directly to and from Nimble Hill Road.

- The southbound exit deceleration lane length of 350 feet is inadequate (460' desired) for the low speed (10-15 mph) curve radius (120') entering Nimble Hill Road.

- There is a very short weave section (350 feet existing/1,600 feet desired) between the SB ramp that enters the Turnpike from River Road and the Exit 4 off ramp to Nimble Hill Road. The safety concerns over the weave are heightened by the high speed of exiting traffic coming off the Little Bay Bridge mixing with the often low speed truck traffic entering the Turnpike from the industrial areas on River Road.

- The on-ramp from Nimble Hill Road is also slow speed (10-15 mph) and contrasts with the required rapid acceleration to enter the flow of high speed

vehicles on the Turnpike. This is particularly true if the entering vehicles are attempting to weave across to Exit 4N in the median to reverse direction, or to connect to Woodbury Avenue at Exit 3.

- There is an Exxon gas station entrance located within approximately 200 feet of the off-ramp nose of the Nimble Hill Road exit. Traffic turning into or out of the gas station from Nimble Hill Road can interfere with other higher speed vehicles using the off-ramp. The gas station also has an entrance onto the Turnpike that is less than 80 feet south of where the Exit 4 SB acceleration lane begins. Vehicles accelerating south from Nimble Hill Road face the possibility that vehicles will enter the Turnpike directly in their path from the gas station.

Exit 4 – NB at River Road

Consists of a northbound right-in / right-out ramp system to a modified tee intersection with River Road.

- The northbound on-ramp has a 100-foot radius that has a design speed just under 20 mph. This reduces the ability of entering vehicles to adequately accelerate to freeway speeds. This is of particular concern at this location since River Road generates a relatively high number of trucks, including loaded fuel trucks, due to the industry located off of River Road.

- The northbound off-ramp only has a 25 mph design speed (180-foot radius). Horizontal sight distance is an issue since the intersection with River Road is approximately 210 feet from the off-ramp.

- The layout of this interchange is somewhat unorthodox since the exiting vehicles are not required to yield or stop as they access River Road. The vehicles entering the interchange from the south on River Road are under stop sign control. After stopping, these vehicles must accelerate between gaps in the free flowing exiting vehicles to access the northbound Turnpike entrance ramp. The safety concerns are magnified by the limited sight distance from the River Road stop sign to the vehicles exiting the Turnpike and by the high number of trucks accessing the Turnpike from River Road. A more traditional interchange would maximize the length of the off-ramp and bring the off-ramp vehicles to a stop at a T-intersection.

- The Exit 4 NB / River Road intersection is a safety concern because of limited sight distances, lack of traffic control, and mix of fast and slower moving vehicles.

Little Bay Bridges Geometric Deficiencies:

- Both bridges lack adequate shoulders. The existing right and left shoulders are 2′-0″ SB and 2′-3″ NB, measured from the travel lane to the face of curb. The

desirable shoulders would be 10 to 12-feet wide on the right and 4 to 6 feet wide on the left for a two-lane layout.

- The profile of the Little Bay Bridges provides adequate stopping sight distance for vehicles traveling 60 mph. The vertical curvature on the bridges, which limits the safe stopping sight distance, continues to rank high on the list of concerns among the traveling public. This may be explained by the combined effect of profile, narrow road width, high traffic volumes with resulting small gaps between vehicles, high speeds, number of decision points (exits and weave areas) in close proximity to the ends of the bridges, and environmental factors such as freezing on the bridge surface, high winds, and motorist distraction by the views of the bay. The Little Bay Bridges have the highest number of accidents in the study area.

Exit 5 NB

Consists of a northbound right-in / right-out ramp system to the east side of Hilton Park and Wentworth Terrace.

- The short 400 foot deceleration lane terminates in a sub-20 mph (60-foot radius) off ramp. The combined result of these two factors yields higher than acceptable vehicle speeds along the off-ramp and contributes to the potential for rear-end collisions when motorists slow down on the Turnpike in anticipation of the slow speed ramps.

- The connector road under the bridges between the east and west sides of Hilton Park is one-way from west to east and therefore limits circulation without use of the Turnpike.

Exit 6 NB -- Dover Point Road & US Route 4

Consists of an eastbound Dover Point Road off-ramp followed by a westbound US 4 off-ramp. There is access to the Turnpike at a short on-ramp from Cote Drive just south of the off-ramp to Dover Point Road.

- The on-ramp is located on the inside of a mainline curve and is so close to the high speed and high use off-ramp that it introduces a very dangerous weave condition. The on-ramp acceleration distance is also inadequate.

- Exit 6W carries heavy traffic volumes in one lane around the 300-foot radius curve designed for 30 mph. There is adequate deceleration distance provided on the approach to the exit when there are light traffic volumes, but this location is known to form a queue of traffic during peak hours thus reducing the usable deceleration length substantially. This forces slow moving traffic into the normal northbound through traffic lanes on the Spaulding Turnpike and it can also interfere with traffic exiting the Turnpike to Dover Point Road.

Exit 6 SB

Consists of a southbound off-ramp south of the Dover Toll Plaza. This ramp connects to Spur Road, and then to US 4 at a signalized intersection near the Scammell Bridge.

Southbound access to the Turnpike at Exit 6 SB from US 4 is via a ramp system that first combines one lane from US 4 with one lane from Dover Point Road. These two lanes merge into one southbound ramp lane and then Boston Harbor Road traffic enters and the resulting two lanes also merge to one southbound lane. The resulting one lane ramp then forms one of the two southbound lanes on the mainline. The two mainline lanes are also merged into one lane just prior to the introduction of the on-ramp lane. Once the lanes are side by side there is little distance for the traffic to jockey for position prior to crossing the bridge where lane changes are prohibited. The only minor observed geometric deficiency is the 60 foot radius on the Boston Harbor Road on-ramp.

3.15.4.3 Interim Safety Improvement Project

Some of the geometric deficiencies on the Newington side of the study area will be addressed by an interim safety improvement project that is scheduled to be constructed in 2005. The project (as depicted in **Figure 3.15-9**) will accomplish the following:

- Closure of the Exit 4N reverse direction loop ramp in the median. This will eliminate the dangerous weaves that currently occur between Exit 4N and Exit 4.

- Realignment of the River Road Extension to intersect Nimble Hill Road instead of the Turnpike mainline. This will eliminate the dangerous weave between the old River Road Extension on ramp and the Nimble Hill Road off ramp.

- The River Road Extension will also be made two-way to provide complete cross access from one side of the Turnpike to the other. This will take the place of the eliminated Exit 4N and will allow vehicles to access sections of Newington on either side of the Turnpike without having to travel on the Turnpike.

- Reconfiguration of the northbound Exit 4 ramps to improve storage and the curve radii and design speeds. The intersection of the ramps and River Road will form a tee intersection.

- River Road will be realigned and widened to include a left turn lane for the NB on ramp.

Proposed Work
Existing Pavement
Wetlands
Resurfacing / Driveway Improvements
Existing Buildings
Water
Buildings to be Removed
Pavement Removal

Interim Safety Improvements

Proposed Interchange Improvements
Exit 4 / River Road / Nimble Hill Road
Newington, New Hampshire
A000(115), 11238-C

New Hampshire DOT
Department of Transportation

Figure 3.15-9

- Reconfiguration of the southbound Exit 4 ramps to improve deceleration and acceleration lengths. The southbound on-ramp from Nimble Hill Road will be separated from the Turnpike mainline by a raised median. This median will extend south of the Exxon gas station drive to provide all entering vehicles with sufficient acceleration distance prior to entering the mainline of the Turnpike.

- Nimble Hill Road will be widened to include a wider shoulder and turn lanes in the vicinity of the new intersection formed with the realigned River Road Extension.

These interim improvements do not address the current or projected capacity needs of the corridor, and are intended as near term solutions to existing safety concerns.

■

3.15.5 Infrastructure Deficiencies

The development of the Spaulding Turnpike has occurred in stages that have largely been driven by the size and type of structure crossing Little Bay. The Turnpike was originally a two-lane facility when the General Sullivan Bridge was constructed in 1935. It was then expanded to be a median divided four-lane facility on the Newington side when the current southbound Little Bay Bridge was built in 1966. When the northbound Little Bay Bridge was constructed in 1984, the General Sullivan Bridge was taken out of service and the Turnpike approaches were realigned exclusively to the Little Bay Bridges. Much of the current Spaulding Turnpike mainline roadway section still predates the Little Bay Bridges. The most recent substantial roadway modifications were related to the reconstruction of the Scammell Bridge over the Bellamy River (completed in 1999). That project included improvements to the southbound ramp system from US 4, Boston Harbor Road and Dover Point Road.

3.15.5.1 Roadway

Much of the existing Turnpike pavement structure is over 40 years old. Regular maintenance of the surface through scheduled paving projects has maintained the surface condition, however the condition of the base materials and the suitability of the pavement structure by modern pavement design standards is questionable.

There is no known concrete base under the pavement, but there are still rails and ties under the pavement where the at-grade railroad (Pease Spur) once crossed both sides of the Turnpike in Newington. There are known areas where there are poor subsoils, including an area between Exit 5 and 6 in Dover where brick rubble was used as fill material beneath the roadway.

The existing drainage structures are as old as the roadway and may require replacement due to their condition, especially where regular salt water exposure

occurs. The capacity of the drainage pipes may also be deficient at some locations due to the amount of impervious area that has been added from development in the area.

3.15.5.2 Bridges

General Sullivan Bridge

The General Sullivan Bridge was constructed in 1935. The structure consists of nine spans with a total bridge span of 1528 feet. The spans consist of steel deck trusses, and a 3-span continuous truss with a through arch truss over the main navigation channel. The main navigation span is 275 feet with a vertical clearance to mean high water of 48'-9" in the center 100 feet and 35'-6" in the center 200 feet (**Figure 3.15-10**). The bridge has been deemed eligible for the National Register of Historic Places.

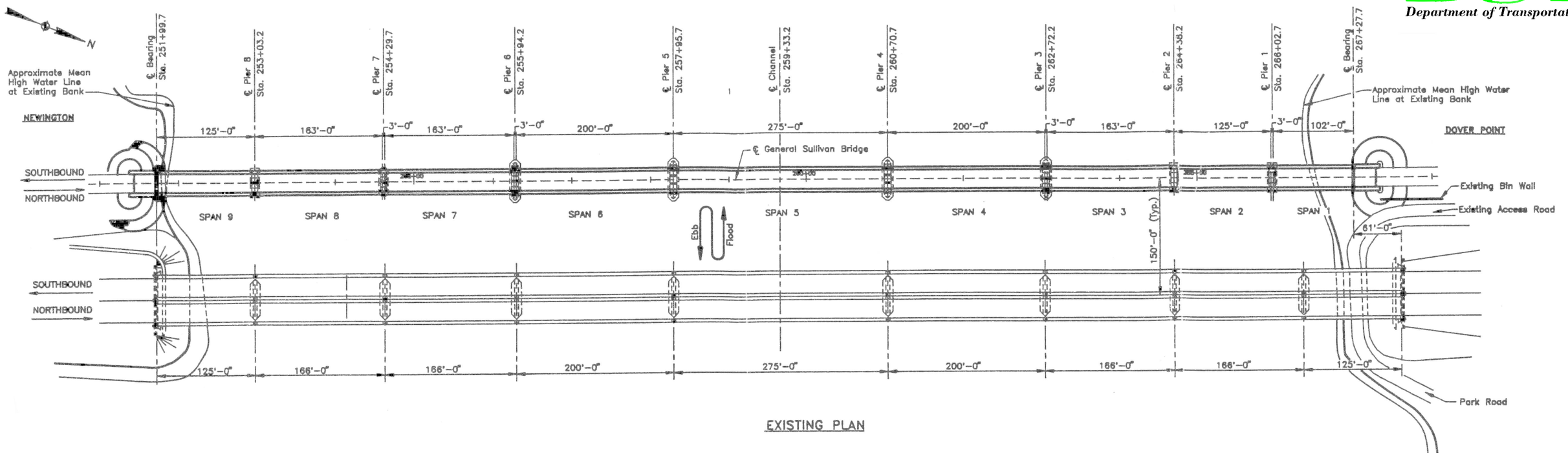
The existing roadway width is 24'-0" curb-to-curb with 5 foot sidewalks (2'-11"sidewalk width at the through truss). Potential roadway widening is limited by a clear width of 30'-7"at the through truss (**Figure 3.15-11**). The roadway profile over the bridge consists of 4% approach and departure grades with a 500-foot vertical curve, which meets the AASHTO standards for a design speed of only 45 mph.

With the construction of the northbound Little Bay Bridge and due to its poor condition, the General Sullivan Bridge was closed to daily traffic in 1984 but currently remains open to pedestrians and bicyclists. The superstructure exhibits deterioration and section loss at the deck, steel stringers, steel floor beams, steel trusses (particularly impacted rust at the connections) and the piers exhibit extensive cracking, scaling, and cavitation below the water line. The structure is deemed seismically vulnerable due to its non-redundant truss members, rocker bearings, and unreinforced granite/concrete piers.

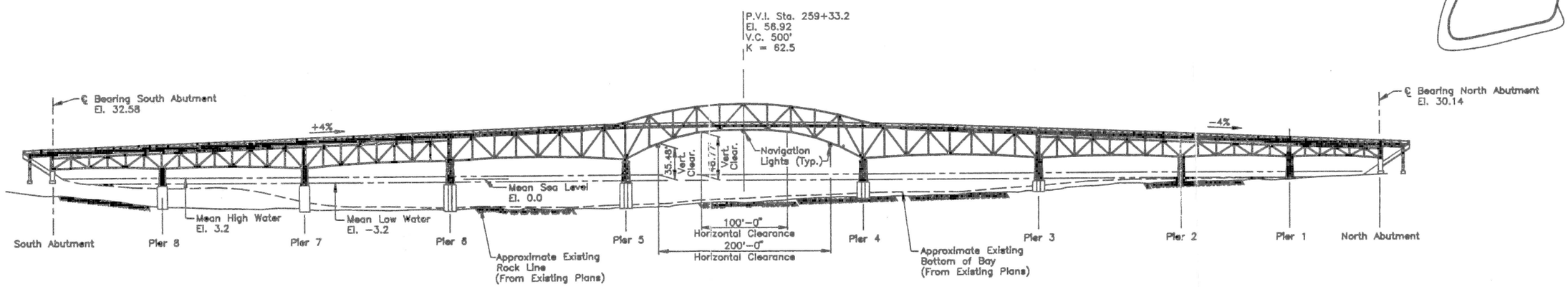
Little Bay Bridges

The Little Bay Bridges, which carry the northbound and southbound Turnpike over Little Bay, consist of two bridges built in phases. The first phase, which constructed the foundations for both bridges and the current southbound superstructure, was built in 1966. The second phase, which constructed the northbound superstructure, was constructed in 1984. Both bridges have 9 spans with a total span of 1,589'. The main navigation span is 275' with a vertical clearance of to mean high water of 46'-8" in the center 100 feet and 45'-1" in the center 200 feet (**Figure 3.15-12**).

The existing roadway width is 28'-0" curb-to-curb on the southbound structure and 28'-6" on the northbound structure (**Figure 3.15-13**). The roadway profile over the bridge consists of 3.5% approach and departure grades with an 1100-foot vertical curve, which meets the AASHTO standards for a design speed of 60 mph.



EXISTING PLAN



EXISTING ELEVATION

Note:
Figures on this sheet are from the Existing Plan and Elevation figure in the report: General Sullivan Bridge over Little Bay Bridges Rehabilitation Final Report prepared by Kimball Chase, Inc. dated June, 1991.

0 50 100 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-10
Existing General Sullivan Bridge
Plan and Elevation

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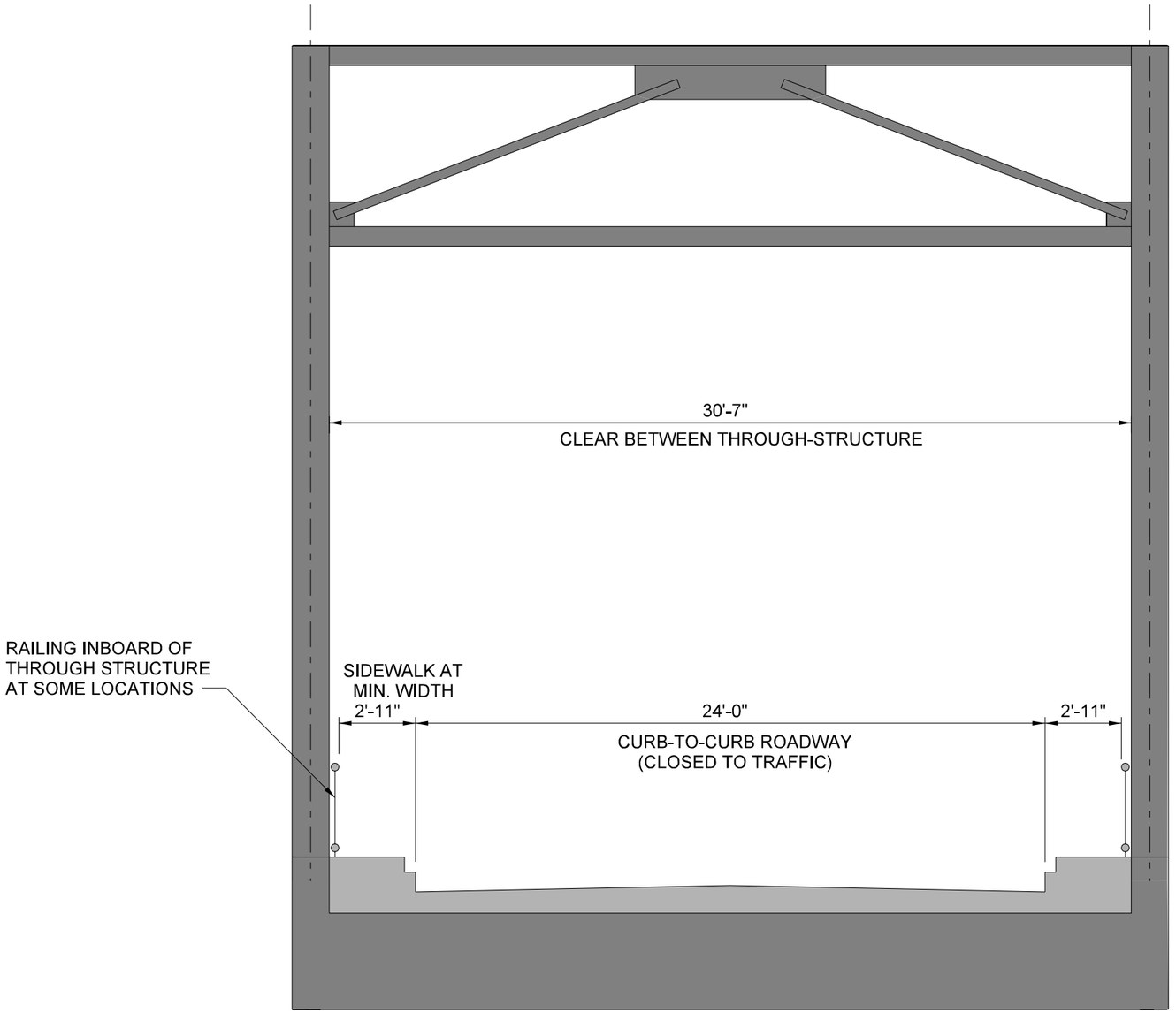

EXISTING CROSS SECTION

GENERAL SULLIVAN BRIDGE

0 2.5 5 Feet

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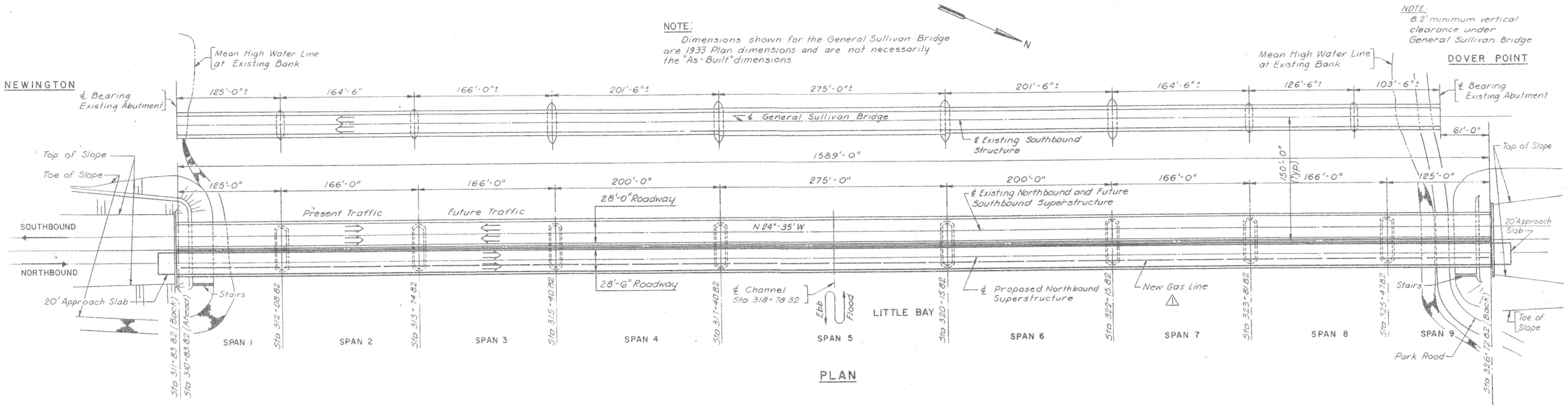
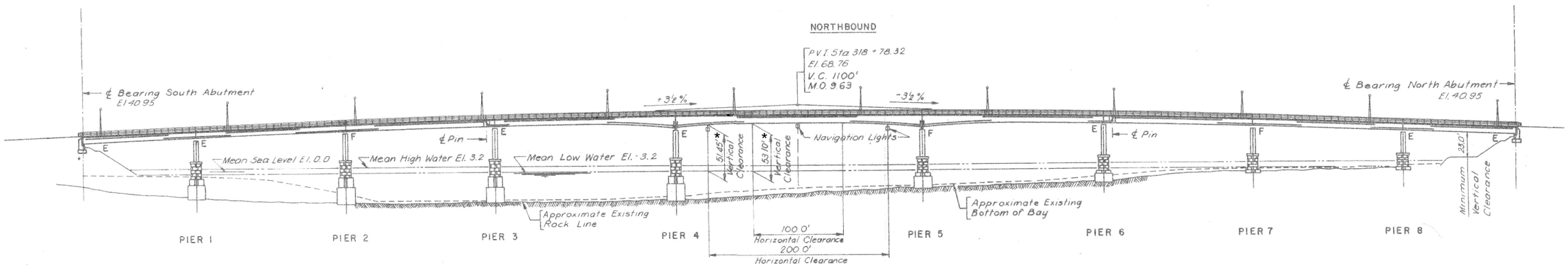
Figure 3.15-11
Existing General Sullivan Bridge
Cross Section

New Hampshire DOT
Department of Transportation



PLAN



ELEVATION

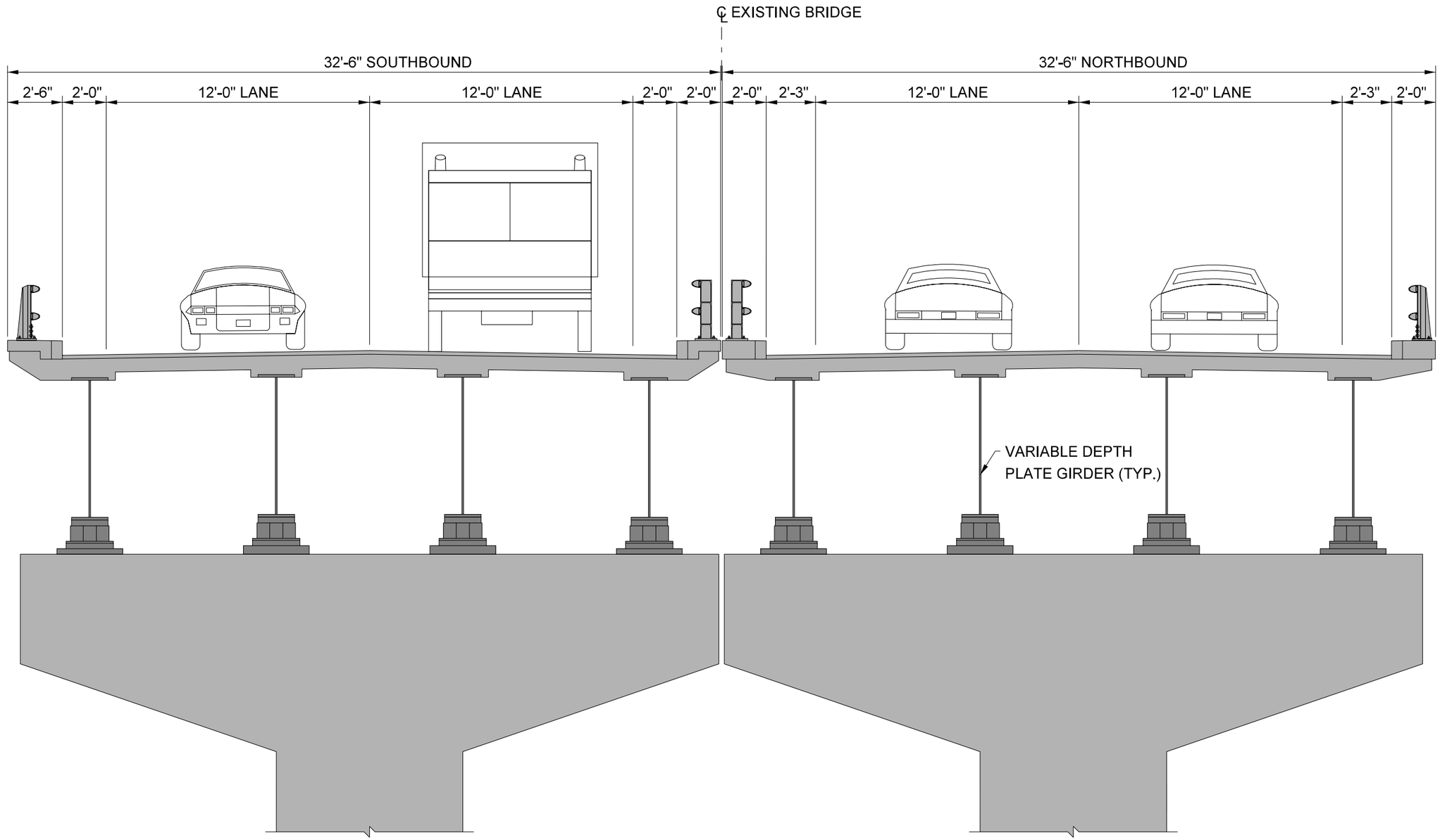
* Clearance dimensions in this figure shown to mean low water.

Note:
Figures on this sheet are from the General Plan and Elevation, NHDOT Project No. P-2222-D, Contract #1, U.S. Route 4, N.H. Rte 16 and Spaulding Turnpike over Little Bay prepared by Hardesty & Hanover, Inc. dated March, 1982.

0 50 100 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-12
Existing Little Bay Bridges
Plan and Elevation



EXISTING CROSS SECTION

LITTLE BAY BRIDGES

0 2.5 5 Feet

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Figure 3.15-13
Existing Little Bay Bridges
Cross Section

Both bridges have a Federal Sufficiency Rating of 63.3 and are noted as being Functionally Obsolete due to their narrow width. The bridges are showing signs of minor deterioration, particularly in steel girders and the pin and hangar assemblies at the expansion joints. At the time (1966) of substructure construction, there were no design requirements for seismic resistance. A review of current standards indicates that the structure does not meet the current standards for seismic design, specifically, the pin and hangar connections, rocker bearings, pier columns, and pier bases.

Other Bridges

Three other bridges fall within the study limits: US Route 4 Westbound over the Turnpike, the Turnpike over River Road SB on-ramp, and the NB Turnpike over Woodbury Avenue. Important features for each of these bridges are listed below:

Roadway	US 4	Spaulding Turnpike	Spaulding Turnpike NB
Feature Crossed	Spaulding Turnpike	River Road SB On-Ramp	Woodbury Avenue
Year Built	1956 (Rehab 1989)	1983	1956 (Rehab 1996)
Length	240 ft.	48 ft.	218 ft.
Number of Spans	4	1	3
Bridge Width	48.3 ft.	104.3 ft.	41 ft.
Vertical Clearance	16.9 ft.	15.1 ft.	14.5 ft.
Sufficiency Rating	98.0	86.2	87.9

■

3.15.6 Transportation Demand Management

3.15.6.1 Park and Ride Lots

To support those who travel by carpool, vanpool, or bus, the NHDOT operates 26 park and ride lots (including some owned by other entities). Although there are no park and ride lots located within the study area, there are several located nearby that could service the motorists of the Spaulding Turnpike (**Figure 3.15-14)**. Table 3.15-8 summarizes the existing nearby park and ride facilities and their current utilization levels. The table also describes the amenities provided at each location.

The largest of the nearby park and ride facilities is located at the Portsmouth Transportation Center on NH Route 33, just west of I-95/Exit 3A. This park and ride lot provides roughly 975 paved spaces, lights, a bus shelter, bike racks and lockers, and public telephones. Public transit is provided by C&J Trailways and COAST. Data collected by the NHDOT in the spring and fall of 2002 indicates that this lot currently experiences a 65 percent utilization rate.

Table 3-15-8
Park and Ride Lot Inventory and Utilization

Town	Location	Paved	Lights	Public Transit	Number of Spaces	Occupancy Spring 2002	Occupancy Fall 2002	Services
I-95 Corridor								
Portsmouth	PTC - NH Route 33 at I-95 Exit 3A	Yes	Yes	Yes	975	634	622	P, S, B, T
Portsmouth	NH Route 33 at I-95 Exit 3B	Yes	Yes	No	50	18	11	P, B
Hampton	Timber Swamp Road at I-95 Exit 2	Yes	Yes	No	103	29	15	P
NH Route 9								
Barrington	NH Route 9 across from Calef's Country Store	Yes	Yes	No	20	8	8	P (nearby)
US Route 4								
Lee	West of the Lee Traffic Circle	No	Yes	No	25	4	8	
NH Route 125								
Epping	NH Route 125 at NH Route 101 Exit 7	Yes	Yes	No	246	62	51	P, S, B
Out of State								
Newburyport, MA	MA Route 113 at I-95 Exit 57	Yes	Yes	Yes	460	460*	460*	P, S,T
Saco, ME	Industrial Road at I-95 Exit 5	Yes	No	No	126	NA	NA	P (nearby)
York, ME	ME Route 91	Yes	Yes	No	152	NA	NA	P (nearby)

PTC - Portsmouth Transportation Center.
Services: P = Phone; S = Shelter; B = Bike Racks and Lockers; T= Lot serviced by C&J Trailways, which provides commuter transit service in the corridor.
NA - Not Available.
* Occupancy rate reported at 100% by Mass Highway Department.

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Figure 3.15-14
Existing Park and Ride Facilities

The other nearby park and ride lots are substantially smaller ranging in size from 25 spaces in Lee (US 4) and Portsmouth (NH Route 33, east of I-95 Exit 3), to 103 spaces in Hampton. None of these facilities have the extensive amenities that are provided at the Portsmouth Transportation Center and none are serviced by public transportation. The lack of public transportation may contribute toward the lower utilization rates at these locations. The 2002 data collected by the NHDOT shows utilization rates of 28 percent in Hampton, 32 percent in Lee, and 36 percent in Portsmouth.

3.15.6.2 Bus Transit Services

There are both public and private bus transit services in Newington, Dover, Durham, Portsmouth, and Rochester (**Figure 3.15-15**). These services include local, commuter, and intercity bus services and local trolley service in Portsmouth. Local bus service primarily services the Portsmouth, Newington, Dover and Durham (University of New Hampshire) areas. Commuter bus service routes offer service from Portsmouth and Dover to Boston. The intercity services operate along the I-95 corridor from Maine through Portsmouth to Boston and New York City. Trolley service is specific to the Portsmouth area. The services provided are described in the following sections.

COAST

The Cooperative Alliance for Seacoast Transportation (COAST) serves the seacoast region of New Hampshire (Rockingham and Strafford Counties) and Berwick, Maine. COAST runs five local bus routes serving Portsmouth, Dover, Newington, Newfields, Greenland, Stratham, Exeter, Newmarket, Rochester, Farmington and Berwick, Maine. Two year-round and one seasonal trolley bus routes are also operated by COAST in the Portsmouth area. In addition, COAST provides on-demand ADA services.

The local bus services generally operate from 6 AM to 7 PM weekdays although Route 2 (Rochester-Portsmouth) service operates until approximately 11 PM weekdays. The two year-round trolley services also operate weekdays from 7 AM to 9 PM. Limited Saturday service is also offered. The seasonal trolley service operates seven days a week from 10 AM to 7 PM.

Fares on the local bus service range from $.75 to $1.75 per trip with a monthly pass offered at $25. The trolley fares are $1.00 per trip with both a three day pass offered at $5.00 and a monthly pass at $15.00. Children under 5 ride free and fares are half price for seniors and disabled individuals.

A brief description of each route is provided in the following paragraphs. The detailed schedules are included in Appendix F.

Routes and Services

Bus Route 1: Nine roundtrips are offered along this route between 6 AM to 6:30 PM weekdays. The service operates from the Dover Transportation Center to Sullivan Street/Pine Hill Road in Berwick with stops in Dover, Somersworth, and Berwick. Transfers to the Route 2 bus and Wildcat Transit's Route 3 bus are available at both the Market Square and Shaw's/Central Avenue stops. Total trip time from along the route is approximately 25 minutes.

Bus Route 2: Service along this route is provided weekdays from 5:55 AM to 11 PM and Saturdays from 6:55 AM to 11 PM. The route operates from Market Square in Portsmouth to the Lilac Mall in Rochester with intermediate stops in Portsmouth, Newington, Dover, Somersworth and Rochester. There are nine northbound trips from Portsmouth to Rochester and 11 southbound trips weekdays. In addition, there are two early weekday morning northbound trips from Waldon Towers/Green Street and two late weekday evening trips from Market Square Shaw's/Central Avenue in Dover. On Saturdays, six roundtrips are operated between Portsmouth and Rochester. Transfers are available to COAST Routes 6 and 7, the COAST trolleys, and Wildcat Transit Routes 3 and 4 along the service corridor. Total trip time from Portsmouth to Rochester is approximately 70 minutes.

Bus Route 6: Service along this route is provided weekdays from 6 AM to 6:30 PM. The route operates from the Main Street fire station in Farmington to the Lilac Mall in Rochester with intermediate stops in both communities. A total of eight roundtrips are provided along the entire route. One evening roundtrip operates between the Main Street fire station and the Wal-Mart store in Rochester. Transfers to the Route 2 bus are available at the Lilac Mall. Total trip time is 30 minutes.

Bus Route 7: Service along this route is provided weekdays from 6:25 AM to 8:30 PM. The route operates from the Fox Run Mall in Newington to the Exeter Train Station with intermediate stops in Greenland, Stratham, Newmarket, and Exeter. Three roundtrips operate over the entire route. One afternoon roundtrip operates between the Fox Run Mall in Newington and the NHCTC/NH 33 stop in Stratham. Transfers to COAST Route 2, the trolleys, and Wildcat Transit Route 4 are available at the Fox Run Mall. A transfer to Wildcat Route 5 is available at the Downtown Gazebo/NH 108 stop in Newmarket. Total trip time from Newington to Exeter is 64 minutes.

Dover Community Routes: The COAST bus Dover Community Routes provide weekday local service to several areas of Dover. The three Dover Community Routes include Dover North, Dover South, and Dover West. The service consists of one inbound morning trip and one outbound afternoon trip on each route. The morning runs start at approximately 6:30 AM and the afternoon runs at approximately 3:30 PM. Trip time over each route is approximately 55 minutes.

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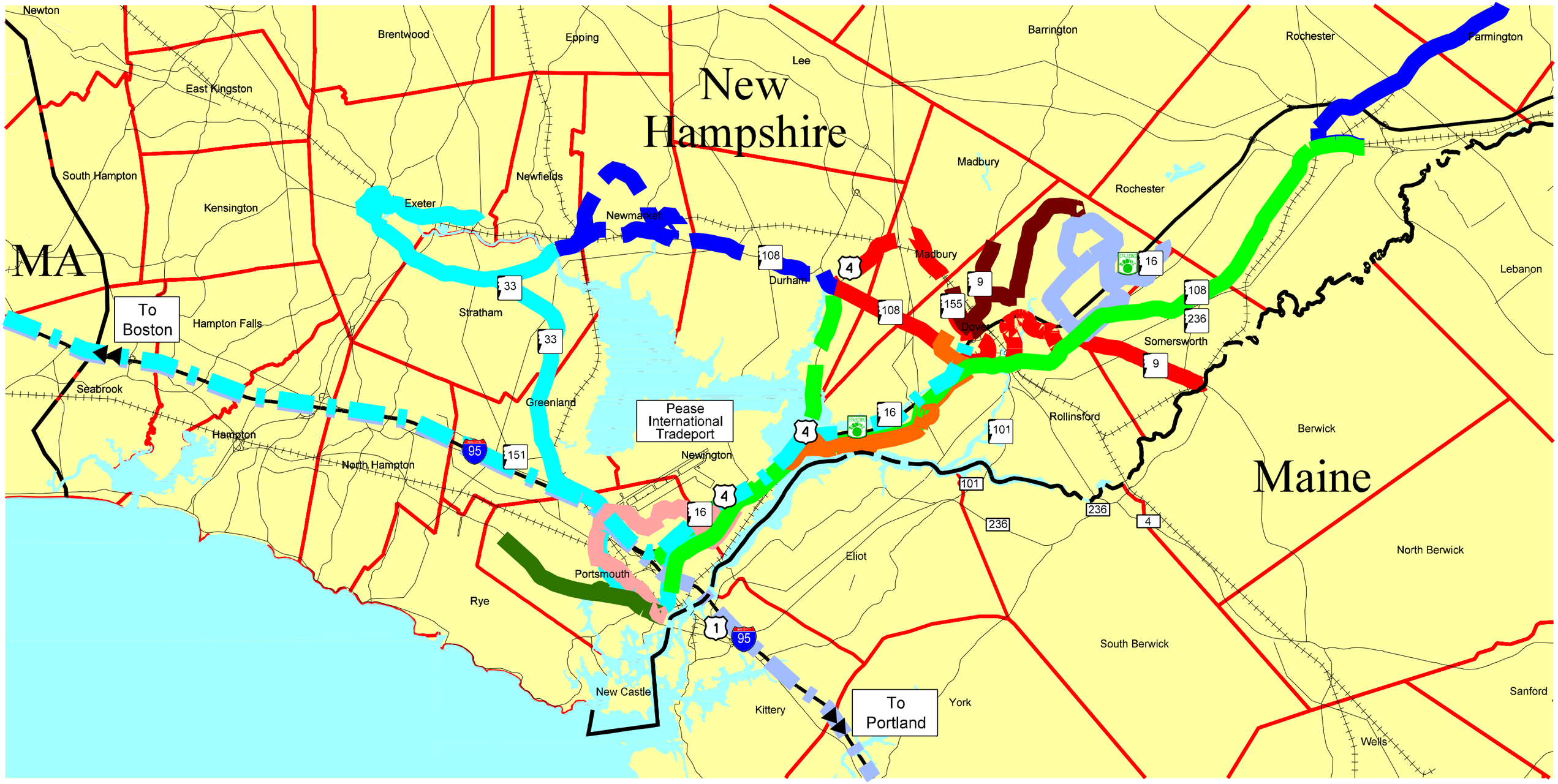

Legend:

COAST Services
- Route 1
- Route 2
- Route 6
- Route 7
- Dover Points North
- Dover Points South
- Dover Points West
- Lafayette Road Trolley
- Pease Tradeport Trolley

Wildcat Transit Services
- Route 3
- Route 4
- Route 5

Commuter/Intercity Services
- C&J
- Vermont Transit

- State Line
- Town Line

N

0 6000 12000 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3.15-15
Existing Bus Services

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COAST Trolley Service: COAST operates two year-round and one seasonal trolley route. The two year-round routes operate weekdays from 7 AM to 8:30 PM and on Saturdays from 7 AM to 7:30 PM. The Lafayette Road service operates from Market Square in Portsmouth to Hillcrest Estates with intermediate stops along Middle Street and Lafayette Road. There are 13 weekday roundtrips and six Saturday roundtrips. One additional inbound trip operates from Hillcrest Estates to Market Square in the morning all six days. Total one way travel time is approximately 20 minutes. Transfers to COAST Route 2, the Pease Tradeport trolley, and Wildcat Transit Route 4 are available at the Market Square stop.

The Pease Tradeport service operates from Market Square to International Drive with intermediate stops on Islington Street, Plains Avenue, Greenland Road, Grafton Drive, Corporate Drive, Rochester Avenue, New Hampshire Avenue, Exeter Street and Gosling Road. Major intermediate stops include the Portsmouth Transportation Center, Pease Tradeport (multiple stops), and Fox Run Mall. There are 13 weekday and six Saturday roundtrips. The one way outbound travel time to Gosling Road is approximately 20 minutes. The return trip time is approximately 30 minutes. Transfers to COAST Route 2, the Lafayette Road trolley, and Wildcat Transit Route 4 are available at the Market Square stop. Other transfer points include the Plaza 800 stop on Islington Street (COAST Route 4) and the Portsmouth Transportation Center (C&J Trailways).

The third trolley route is the seasonal downtown Portsmouth service. Daily service is provided from the end of June through early September. On weekdays and Saturdays, the service operates from 10:15 AM to 6:45 PM and on Sundays it operates from 11:15 AM to 6:45 PM. Trolleys depart every 15 minutes from Market Square to many of the city's attractions including its historic parks, neighborhoods and waterfronts.

ADA Services: COAST also operates on-demand ADA services for customers that are not able to use the regularly scheduled services. A customer may call COAST and schedule an ADA trip to meet their needs.

Existing Ridership

Table 3.15-9 presents annual ridership for the various COAST routes and services. The two most current years (FY2001 and FY2002) are provided.

Table 3.15-9
COAST Bus and Trolley Annual Ridership Numbers

Route	Fy2001	Fy2002
Route 1 (Dover-Somersworth-Berwick)	34,634	37,819
Route 2 (Rochester-Somerset-Dover-Newington-Portsmouth)	89,171	89,083
Route 6 (Farmington-Rochester)	7,779	9,880
Route 7 (Exeter-Stratham-Newmarket-Greenland-Newington)	5,262	5,737
COAST Trolley (Pease Tradeport and Lafayette Road Routes)	32,417	32,783
COAST Trolley (Downtown Loop Route)	7,374	2,885
Dover Community Routes	-	3,856
ADA Paratransit/other	3,101	9,315
Total Ridership	179,738	191,358

Recently Initiated and Proposed Services

COAST initiated the updated Pease Tradeport and Lafayette Trolley routes in June, 2003. They are nearing completion on a study of their entire system to review opportunities for a more efficient service and better connectivity between their routes. The goal of the study is to provide more regular headways. Other future service plan modifications include a CMAQ funded program to implement a Downtown Transit Loop in Dover. This service is projected to begin in the summer of 2004. COAST also has another CMAQ funded project to operate three express buses during peak periods on the Spaulding Turnpike between Rochester and the Portsmouth Transportation Center at Pease Tradeport. This project is projected to be implemented in 2006.

Wildcat Transit

Routes and Services

Wildcat Transit is a public transit service operated by the University of New Hampshire. It serves the university campus and local communities including Durham, Dover, Portsmouth, and Newmarket. They operate three public transit routes (Routes, 3, 4 and 5). The service frequency varies depending on the academic calendar. During UNH's academic school year, the three routes are operated daily. Each route has eight to nine weekday roundtrips between 7:00 AM and 10:00 PM. There are four roundtrips on Saturdays and Sundays. During the winter months, some service runs until 2:00 AM. A reduced service plan is operated during UNH's scheduled semester breaks. During reduced service periods, there are two runs per day on weekdays and no weekend service. Wildcat buses circulate through the core UNH campus before departing on their routes. Fares are $1.00 per ride (free with UNH Identification) for all routes.

The Route 4 bus is the only route that uses the Spaulding Turnpike and the Little Bay Bridges. Many of the Route 4 stops in Newington and Portsmouth are shared with COAST services. Wildcat Transit Routes 3 and 4 provide transfers to COAST services.

Existing Ridership

Table 3.15-10 presents the annual ridership for FY2001, FY2002, and FY2003. Annual ridership has been growing and consists mainly of students and facility/staff to and from the campus for both commuting and for shopping and recreational trips outside the campus. Ridership increased 5 percent in 2002 and 8 percent in 2003.

Table 3.15-10
Wildcat Annual Ridership Numbers

Route	FY 2001	FY 2002	FY 2003
UNH Routes 3, 4, 5	110,486	127,754	142,216

Recently Initiated and Proposed Services

UNH is currently in the process of converting its mixed gas and diesel fleet to compressed natural gas (CNG). With over 13 of the existing diesel buses greater than 10 years old, UNH is applying for a CMAQ grant for replacement of these aging buses with new CNG buses. A fast-fill CNG fuelling facility is being built on the UNH campus with federal funding. Wildcat Transit is also in the process of expanding the frequency of service on all routes.

C & J Trailways

Routes and Services

C & J Trailways, a privately owned bus company, offers commuter bus service from Dover and Portsmouth as well as Newburyport, MA to Boston's Logan Airport and South Station. This service utilizes seven state-owned coaches as well as C&J owned vehicles. The service plan is summarized in **Table 3.15-11**.

Table 3.15-11
Commuter Bus Schedule

Inbound To Boston	Total Daily Trips Logan Airport	Total Daily Trips South Station
Weekday:		
from Dover	0	11
from Portsmouth	18	20
from Newburyport	18	19
Weekend:		
from Dover	0	7
from Portsmouth	18	12
from Newburyport	18	12

Table 3.15-11 (continued)

Outbound From Boston	Total Daily Trips To Newburyport	Total Daily Trips To Portsmouth	Total Daily Trips To Dover
Weekday:			
South Station	19	19	13
Logan Airport	17	17	1
Weekend:			
South Station	12	12	8
Logan Airport	16	16	1

Bus stops and facilities are located in Dover and Portsmouth and Newburyport and Boston, Massachusetts. The state-owned Portsmouth Transportation Center at Pease International Tradeport serves as C & J's bus terminal and administrative offices. The Transportation Center includes ticket agents, information for local areas of interest and an approximately 975 space parking facility for commuters.

C & J currently provides commuter bus service to and operates the Dover Transportation Center. This facility is also a stop for Amtrak's Downeaster and the COAST and Wildcat transit lines. The Newburyport terminal, which includes over 400 park and ride spaces, is located at the intersection of Route 113 and Interstate 95. There is also a small ticket office in Newburyport. The Boston terminal is located at South Station. This facility includes Amtrak Northeast Corridor intercity train service, MBTA commuter rail service, and the MBTA Red Line. During 2004, the MBTA's new Silver Line bus rapid transit service will commence operation from South Station.

Existing Ridership

C& J Trailways' ridership is approximately 350,000 passengers per year with the ridership derived from Dover, Portsmouth and Newburyport as follows:

Dover: 4%
Portsmouth: 60%
Newburyport: 36%

Approximately 65 percent of the riders travel to South Station while 35 percent are traveling to Logan Airport.

Vermont Transit

Routes and Services

Vermont Transit, a private bus operator, provides service from Maine, New Hampshire, and Vermont to Boston and New York City. Within the region, Vermont

Transit provides bus service to Portsmouth. This service however, is primarily an intercity service for long distance travelers to Boston and New York. Vermont Transit has bus stops and facilities throughout New Hampshire, Vermont, Maine and Massachusetts. Stops and terminals along the route that serve the study area include:

- Portsmouth, New Hampshire – A stop at the Federal Cigar Store at 10 Ladd Street.
- Portland, Maine – The terminal is located at 950 Congress Street.
- Newburyport, Massachusetts – The terminal at the intersection of Route 113 and Interstate 95 is shared with C&J Trailways.
- Boston, Massachusetts – The service operates from South Station.

Existing Ridership

Actual current ridership data for the service was not available. Representatives of Vermont Transit estimated that the annual ridership from Maine south through Portsmouth is approximately 170,000 riders, with approximately 10 percent of the riders (17,000) boarding or alighting in the Portsmouth area.

Other Transit Services

The Route 16 Corridor Protection Study recommended initiation of bus service in the Route 16 corridor. The Department of Transportation has been unable to negotiate with a bus operating company to provide such a service.

3.15.6.3 Rail Transit Services

The National Railroad Passenger Corporation (Amtrak) operates intercity passenger rail service between Portland, Maine and Boston, Massachusetts for the Northern New England Passenger Rail Authority (NNEPRA). This service operates along the Main Line West Corridor just north of the study area. No other passenger rail services currently operate within or adjacent to the study area.

As discussed in Chapter 2, several rail corridors have been identified for the evaluation of passenger and freight rail services as part of this study. The corridors to be evaluated include the Main Line West, Main Line East (Hampton Running Track), the Conway Branch, the Portsmouth Branch, the Newington Branch, the Pease Spur, and the Sawyer/Dover Branch. These seven rail corridors are shown in **Figure 1.2-3**. The following sections summarize the existing *Downeaster* passenger rail service and the existing conditions along the rail corridors being evaluated.

Downeaster

Route and Service

Regular service on the *Downeaster* intercity passenger rail service commenced on December 15, 2001. Prior to its implementation, passenger rail service between

Portland, Maine and Boston, Massachusetts had not operated since 1965. The service includes a total of ten stops including the termini at North Station in Boston and Portland in Maine. The stops are at Portland, Old Orchard Beach, Saco, Wells, Dover, Durham, Exeter, Haverhill, Woburn (Anderson Transportation Center), and Boston (North Station).

Four daily round trips are presently scheduled to make the 114-mile trip in 2 hours and 45 minutes. A one-way fare from Dover to Portland is approximately $10 and from Dover to Boston is approximately $15. The roundtrip fares are approximately $17 and $27 respectively. A discounted ten trip pass is available for $85 for use between Dover and Portland and $128 between Dover and Boston. There is also a monthly commuter pass that costs $160 for the Dover to Portland trip and $240 for the Dover to Boston trip.

Existing Ridership

Table 3.15-12 summarizes the ridership on the *Downeaster* service for 2002, its first full year of operation. The monthly ridership varied from a low of approximately 19,300 trips in December 2002 to a high of approximately 30,700 trips in August 2002. The ridership was fairly strong through the first eight months of operation as many travelers experienced the new service. The last four months of 2002 saw a drop in monthly ridership of approximate 5,000 to 10,000 trips.

Table 3.15-12
Downeaster Ridership 2002 (One-way Trips)

Month	Total
January	20,235
February	25,824
March	25,119
April	29,628
May	24,039
June	25,704
July	29,683
August	30,714
September	20,118
October	21,916
November	19,501
December	19,313
Total	291,794

Recently Initiated and Proposed Services

NNEPRA and Maine DOT are currently developing a business plan addressing the long-term sustainability of the *Downeaster* intercity passenger rail service. This plan

will examine opportunities to improve the overall performance of the existing intercity rail service. As part of the plan, NNEPRA is considering service changes and enhancements to attract additional ridership. Any potential changes however, are subject to the successful resolution of operational, funding, and jurisdictional issues between NNEPRA, Maine DOT, the Massachusetts Bay Transportation Authority (MBTA), Amtrak, and Guilford Rail System (GRS).

Main Line West Corridor

The Main Line West is part of GRS's Freight Main Line that extends from eastern New York to northern Maine. Freight service is operated by Springfield Terminal Railway (STRY) a subsidiary of GRS. Several through freight trains along with local freight service are operated daily over the route. The New Hampshire Northcoast Railroad (NHN) also operates freight trains over this line. Amtrak operates the *Downeaster* intercity passenger service for Northern New England Passenger Rail Authority (NNEPRA).

The infrastructure for the Main Line West Rail Corridor is in excellent condition, having been recently upgraded to support the initiation of passenger rail service. The maximum authorized speed is 60 mph where the track geometry and other conditions allow. The MBTA has examined the feasibility of extending the Haverhill Line commuter rail service to Plaistow on several occasions. These efforts are currently on hold as NHDOT pursues a commuter rail service extension from Lowell to Nashua.

Main Line East Corridor

The Main Line East is an active freight line that extends from the Portsmouth Line and Yard in Portsmouth to the Foss Manufacturing site in Hampton. This line is approximately 10 miles long and is currently used for freight service. The Main Line East is owned by Boston & Maine Corporation (B&MC) and operated by STRY. South of Hampton to the state line, the rail line is abandoned and the right-of-way has been acquired by NHDOT. The rail bridge across the Merrimack River has been out of service for a number of years and will require extensive rehabilitation or replacement to become operational.

The physical condition of the infrastructure along the line is poor. Train speeds are limited to 5 mph due to the condition of the track. In New Hampshire, the four undergrade bridges, five crossings, and track structure along the active line would require substantial improvements to support passenger rail service. In addition, complete reconstruction of the line would be required between Hampton and the MBTA commuter rail station in Newburyport. A signal and communications system would also be required. Operational, funding, and jurisdictional issues between the MBTA, NHDOT, and GRS would also need to be addressed.

Conway Branch Corridor

The Conway Branch extends from Rollinsford where it connects with the Main Line West to Conway, a distance of approximately 72 miles. There are two active segments and one inactive segment along the branch. The infrastructure along the 42-mile segment between Rollinsford and Ossipee, owned by New Hampshire Northcoast Railroad (NHN), is in good condition. The line has been gradually rehabilitated by NHN in two distinct segments. The initial work, completed in the 1980's, upgraded the segment between Rochester and Ossipee. Between 1994 and 1999, NHN completed an upgrade of the segment from Rochester to Rollinsford. The track structure can support up to a maximum authorized speed of 40 mph where conditions permit for freight operations. Additional improvements may be necessary to support passenger rail service depending on the type of service proposed.

As mentioned above, the middle section of the corridor from Ossipee to Conway has been out of service since 1972. A complete rehabilitation of the line's infrastructure would be required to support the resumption of rail service.

The infrastructure along the northern section, owned and operated by CSR is in good condition. The current track structure can support up to 25 mph maximum authorized track speed where conditions permit. Additional improvements may be necessary to support passenger rail service depending on the type of service proposed.

Newington Branch

The Newington Branch is an active freight line that extends from the town of Newington to the Portsmouth Branch in Portsmouth. This 3.5-mile branch is owned by B&MC and operated by the STRY. It runs just east of the Spaulding Turnpike. Historically, this branch formed the southern section of the rail line that connected Portsmouth with Dover. The line crossed Little Bay just east of the existing General Sullivan Bridge. The rail bridge was removed in 1934. The infrastructure along the line is generally poor. Freight train speeds are limited to 5 mph.

Portsmouth Branch

The Portsmouth Branch is an active freight line that extends from Newfields on the Main Line West through the Portsmouth Yard to the Newington Branch. It connects with the Main Line East at Portsmouth Yard. This 10-mile segment of track is owned by B&MC and operated by the STRY. The condition of the infrastructure along this branch is poor. Train speeds are limited to a maximum of 5 mph.

Sawyer's/Dover Branches

The former Sawyer's Branch extended from the 2nd Street Yard in Dover on the Main Line West south to Sawyer's Mill on the Bellamy River, a distance of 1.5 miles. It was

abandoned in the mid-1970's. The Dover Branch continued south of Sawyer's Mill to Dover Point. It was abandoned in 1941. Spur Road and a portion of the Spaulding Turnpike have been built over the former five-mile branch.

Pease Spur

The Pease Spur extends from the Newington Branch into the Pease Tradeport. The initial 1.6 miles of track is still in place but is out of service. A portion of the spur crosses the Spaulding Turnpike at grade. This crossing has been removed and paved over. Some of the track still exists on the Tradeport site but is in poor condition.

Current Rail Initiatives

Several prior studies documenting the feasibility and cost of passenger rail service to the Seacoast Region of New Hampshire have been completed over the past 10 years. These prior studies included:

- *Restoration of Passenger Rail Service between Boston, Massachusetts and Portland, Maine*, a series of reports including an Environmental Assessment prepared for the Maine Department of Transportation by Vanasse Hangen Brustlin, Inc.

- Commuter Rail Service to Coastal New Hampshire: A Feasibility Study for the Hampton Branch, prepared by the Rockingham Planning Commission, June 1999.

The Maine DOT Portland-Boston study efforts completed in the mid-1990's resulted in the December 2001 implementation of the *Downeaster* intercity passenger rail service. The RPC study of commuter rail service concluded that the service is feasible and that the state and region should develop a plan towards implementation. The RPC has contracted with the NHDOT to conduct an alternatives analysis of a commuter rail extension.

There are no other current study efforts to extend commuter rail service or expand existing commuter or intercity bus services within the Seacoast Region. In fact, the MBTA has recently suspended efforts on several planned commuter rail expansion projects to refocus on the preservation of the existing system. On the intercity rail front, NNEPRA and Maine DOT are working on a business plan for the *Downeaster* service. This plan will examine opportunities to improve the overall performance of the existing intercity rail service.

In addition, the feasibility of extending the Haverhill Line commuter rail service to Plaistow has been evaluated on several occasions by the MBTA. With the reconstruction of the track between Haverhill (Massachusetts) and Portland (Maine) to support the Boston to Portland intercity service, the extension of commuter rail service to Plaistow has become more feasible. The Boston to Portland intercity project addresses a number of the track and signal and communications system

issues that the study for the Plaistow project previously encountered. Track and signal improvements associated with the Boston to Portland project will allow trains to operate at speeds up to 60 mph.

3.15.6.4 Ride-share Program

The NHDOT operates a Statewide Ride-share Program through its Bureau of Rail and Transit. The program is approximately 10 years old, but has not yet built a substantial database. There are currently about 555 commuters registered statewide for ride-matching, but no information is available on the number of carpool/vanpool groups that have been formed through the program.

The State's Ride-share Coordinator also promotes ridership through individual employers by sponsoring transportation events, providing marketing materials, and encouraging employers to adopt TDM strategies such as guaranteed ride home programs, parking management, flextime, and telecommuting. In this process, the State mainly targets rural areas, and depends on the Regional Planning Commissions to work with the employers in the urbanized areas.

The Pease Development Authority (PDA) helped create the Greater Portsmouth Transportation Management Association (TMA). The TMA provides ride-matching services for employees in the Portsmouth area. This TMA is just in the beginning stages of development; therefore, there was no information available on the number of people registered in the program or if any carpools had been formed. See below for further discussion of TMA. See below for further discussion of TMA Initiatives.

3.15.6.5 Transportation Management Association (TMA) Initiatives

The goal of the Greater Portsmouth TMA is to encourage employees to use other modes of transportation such as transit, carpool or vanpool. In addition to the Ride-matching and Guaranteed Ride Home Programs, the TMA provides information on existing transit services provided by Coast, Wildcat Transit, C&J Trailways, Vermont Transit and Amtrak. The TMA also helps employers set up Commuter Choice Initiatives. Commuter Choice Initiatives provide tax savings to employers and/or employees who do not drive alone to work.

There are currently seven employer members of the TMA. Employers who join the TMA can also participate in the Commuter Choice Initiative Program. This program, initiated by the U.S. Department of Transportation and the U.S. Environmental Protection Agency, encourages employers to offer benefits such as:

- Flexible work schedules,
- Telecommuting,

- Tax-free vouchers or passes for transit and vanpools, and
- On-site services such as daycare, food services, and ATMs.

3.15.6.6 Other Initiatives

The Seacoast MPO has created an Alternative Transportation Guide available on the internet. The web site, http://www.rpc-nh.org/Transit/seacoast-transit-home.htm, contains information regarding ride-matching services, transit, park and ride lots and bicycle commuting. The website also includes links to additional websites which contain specific information about each service.

The Seacoast Area Bicycle Routes (SABR) is very active in promoting and supporting bicycle routes in the Seacoast area. Their goal is to "promote a safe and effective bicycle transportation network by encouraging a community approach".

4

Issues and Constraints

Chapter 4 of the Scoping Report summarizes the key issues to be addressed during the remainder of the EIS study process. Most of the key resource issues and constraints have been discussed in Chapter 3 – Affected Environment. For parallel analysis purposes, the issues of primary concern are discussed in Chapter 4 under the same subject headings used in Chapter 3.

4.1 Topography, Geology and Soils

Much of the study area consists of gently rolling hills or essentially flat terrain with a few areas rising to 80 feet above sea level. No significant areas of ledge are located within the project area, and most soils in the area are comprised of marine, till or urban land. It is not anticipated that topography, geology or soils would present significant environmental constraints to this roadway improvement project. At this time it is not envisioned that large-scale cut or fill operations, or bedrock blasting will occur as part of this project.

National Pollutant Discharge Elimination Systems (NPDES) permitting requirements (relative to erosion controls during construction) will apply to the project. The project is also subject to monitoring under state regulations applicable to site disturbance during construction.

4.2 Surface Water Resources

Water Quality

The study area includes several perennial streams, including Pickering Brook, Flagstone Brook, Railway Brook, Paul Brook and an unnamed tributary to the Piscataqua River. Additionally, the dominant environmental feature of the study area is the Little Bay tidal estuary at its confluence with the Piscataqua River. The study area also includes a portion of the tidal Bellamy River. Two small ponds are located in the eastern portion of the study area in Newington. Associated with these resources are a variety of freshwater and tidal habitats supporting economically important species. As discussed in Chapter 3, the EIS will contain a full inventory of

these resources, including potentially affected marine habitats associated with the Great Bay estuary in the vicinity of the Little Bay and General Sullivan Bridges.

Protecting water quality in these resources will be a key environmental issue, as highlighted in comments received during project scoping from the NHDES and the OSP-NH Coastal Program. The increasingly urbanized nature of much of the study area has contributed to a decline in water quality in some of the study area surface waters. The addition of impervious area through an upgrade of the Spaulding Turnpike could lead to an increase in local stormwater runoff. Therefore, potential stormwater impacts will need to be assessed during evaluation of project alternatives, and appropriate Best Management Practices will be developed during the conceptual design phase.

Navigation and Hydrodynamics

The Little Bay and General Sullivan bridges span an area in Little Bay that is an important navigational channel, providing access from the Great Bay to the Piscataqua River and then to the open ocean. The area where the bridges are located can be described as a tidal rapid. All tidal waters entering and leaving Great Bay, Little Bay, and their associated tributaries pass through the constriction between Dover Point and Bloody Point in Newington, resulting in unusually strong currents. In addition to being a major environmental factor affecting the ecology of the area, these strong currents have a direct effect on navigation within the Little Bay vicinity.

The USCG, in its scoping phase comments, has expressed concerns relative to the project's potential impacts on navigation including a recommendation to remove the General Sullivan Bridge. During previous permits issued for reconstruction of the Little Bay Bridge in the 1980s, the USCG stipulated that the General Sullivan Bridge is to be removed if no longer used for transportation purposes. The project will ultimately require a permit from the USCG under its permitting authority pursuant to Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946, and so impacts to navigation will be thoroughly studied. (See further discussion in Section 4.15 below.)

Modification to the Little Bay and/or General Sullivan Bridges has the potential to affect navigation directly by the change in bridge deck height and/or addition or extension of bridge piers. Indirect impacts to navigation (as well as potential environmental effects) could result from changes to tidal currents which is currently under study by the University of New Hampshire, and will be discussed as part of the EIS impact analysis.

To assist with assessment of these potential impacts, a hydrodynamic model of the existing conditions in the Little Bay as well as various bridge alternatives will be developed. The ACOE hydrodynamic model FESWMS and/or RMA II is planned to be used in combination with the Surface Water Modeling System developed by Brigham Young University to model the tidal currents in two dimensions. Three case

studies will be modeled including widening of the existing Little Bay Bridges, removal of the General Sullivan Bridge, and construction of a new bridge with removal of both the Little Bay Bridges and the General Sullivan Bridge.

4.3 Floodplains

The study area contains floodplain areas associated with the Little Bay as well as lower portions of Pickering Brook and Paul Brook. Therefore, an evaluation of potential impacts on floodplains is required under the provisions of Executive Order 11988, "Floodplain Management," 23 CFR 650A, and the National Flood Insurance Program (NFIP). In particular, the NH Office of Emergency Management (NHOEM) has indicated concern relative to the Special Flood Hazard Zone associated with the Little Bay and General Sullivan bridges.

The general concern with flooding issues will require an analysis of the following issues as the EIS is developed:

- The potential for increased runoff due to additional highway pavement area.
- The potential displacement of flood storage resulting from additional highway infrastructure.
- The capacity of new or existing culverts and bridges to convey increased flows (if any) resulting from additional highway infrastructure. This general concern applies to all tributary crossings by the improved highway.

As discussed in Section 3.3, the location and elevation of the floodplain in Newington is an open question. Existing HUD mapping appears to be inconsistent with other flood data studies in Portsmouth, Dover and other seacoast communities. Resolution of the correct floodplain data in Newington will require additional analyses and coordination, due to the conflicting nature of the existing data. Further coordination between NHDOT, FEMA, NHOEM and the Town of Newington and City of Dover will occur prior to and during the development of the DEIS.

4.4 Groundwater Resources

Public and community water supply wells in the region fall outside of the study area, and most residences and commercial industrial facilities within the study area are supplied via systems in both Newington and Dover. Two known private water supply wells are located in the northeastern portion of the study area in Dover, and large portions of Dover Point are stratified drift aquifer, an important groundwater resource. The addition of impervious surface through corridor upgrade alternatives could have some slight adverse effect on the stratified drift aquifer. Perhaps more

importantly, additional runoff may have the potential to affect wells located within the study area. Due to the relatively few wells located within the study area, this potential effect is not expected to be of major concern, but the EIS will address the issue. Further coordination with the Groundwater Protection Bureau of the NHDES will occur during the development of the DEIS.

4.5 Farmlands

Portions of the study area are mapped as potential farmland soils and some active agricultural activity is present within the study area. Active farmland production includes hay fields and blueberry stands in Newington (near Nimble Hill Road and Patterson Lane) as well as Dover (at Dover Point Road). While areas of farmland soils exist within the study area, much of the area is urbanized and direct impacts to agricultural activities and/or important farmland soils are expected to be relatively minor. Additional coordination with the USDA NRCS will occur during development of the Draft EIS to assess potential impacts to farmlands.

4.6 Wetlands Resources

Wetland impacts must be addressed under the ACOE Highway Methodology, a process that merges the NEPA/Section 404 requirements to facilitate decision-making. Wetland issues must also be addressed under Executive Order 11880, State of New Hampshire regulations, and local wetland regulations. To comply with all levels of wetland regulations, the proposed Newington-Dover project must pass the following "sequencing test" of the 404(b) (1) Guidelines.

First, it must be shown that wetland impacts are being avoided to the maximum extent practicable (*i.e.*, within reasonable economic and engineering design parameters). Then wetland impacts that cannot be avoided must be minimized through special engineering design techniques (*e.g.*, steeper than normal fill slopes, crossing wetlands at narrowest possible locations, *etc.*, as practicable). Finally, compensation for the unavoidable loss of wetland functions must be provided. Compensation can be provided by creating new wetlands, enhancing existing wetlands, restoring degraded wetlands, preserving important existing wetland/upland systems, or some combination of these techniques.

Potential impacts to freshwater wetlands may result from upgrades to the highway corridor (widening or reconstruction), particularly from changes in the vicinity of Exits 4 and 6. Intertidal and/or subtidal (estuarine) wetlands would be affected by alternatives that propose reconstruction or extension of bridge piers or any alternative that proposes realignment of the highway to the east between Exit 5 and 6 (near Pomeroy Cove).

During project scoping, members of the public expressed concern about potential impacts to Pomeroy Cove, an estuarine wetland resource on the eastern portion of Dover Point. This area is in close proximity to the existing Spaulding Turnpike. Special attention to this area will be needed to ensure that project impacts are minimized. Both direct impacts and indirect impacts (*e.g.*, stormwater treatment) to this area will be closely examined during the development of project alternatives and impact analyses.

Comments received from the ACOE and representatives of the NHCP discuss potential wetland mitigation measures. The ACOE has expressed a preference for wetland restoration as a primary mitigation measure, suggesting that areas of historic fill exist within the study area based on the long history of land use in the area. Project mitigation, therefore, might be focused on restoration of either tidal or freshwater wetlands by removal of previous fills.

Representatives of the NHCP agree with the restoration approach, but also suggest that a component of the mitigation package address water quality issues. Noting the relatively high urbanization of the study area, the NHCP suggested that an evaluation of stormwater Best Management Practices be made, especially in the Newington portion of the study area where water quality, particularly in Paul Brook, has been in decline.

4.7 Vegetation and Wildlife Resources

Terrestrial Wildlife Habitat

Selected plant and animal species of management concern have been identified within or near the existing highway corridor (see discussion in Section 3.7). Field confirmation and follow-up will be necessary to document the character and extent of biological resources within the study area, and to determine whether meaningful wildlife/habitat impacts may occur.

Based on background research and site reconnaissance conducted during the scoping phase of this project, the primary issue relating to wildlife resources is the additional loss of both terrestrial and aquatic (*i.e.*, wetland) habitats in the study area. This loss will add to the cumulative loss of natural habitats that has already occurred in the area due to accelerated commercial and residential development in the last 25 years. Because of their urban locations and small size, these habitats are frequently viewed as being of lesser value than larger contiguous blocks of forested habitat. The Turnpike itself currently poses a substantial barrier to wildlife movement. Repositioning of interchange ramps or other realignments, along with the potential highway widening, may further fragment habitats and may disrupt the few remaining travel corridors in the study area. Historically many of these habitats

have been of particular importance as resting or layover areas for a wide variety of migratory birds, including neotropical migrants.

Rare, Threatened and Endangered Species

Information from the NHNHB, NHF&GD, and the USFWS indicates that the study area may contain populations and/or habitat for listed threatened and endangered species.

Potentially affected plant species and natural plant communities include the prolific knotweed in the vicinity of Hilton Park and the SNE Calcareous Seepage Swamp and the bulbous bitter-cress to the northwest of Exit 1. Rare wildlife species within the study area may include Henslow's sparrow, bald eagle and the New England cottontail.

The locations of potentially affected plant populations are fairly well known. Additional field work will be performed to confirm the population location and size. This additional survey is particularly important for the prolific knotweed, which has historically been identified in an area that may potentially be impacted by construction. However, the population is known only from historical records and may, in fact, be extirpated from the vicinity.

Additional work will also inventory potential populations and habitat for rare wildlife species, including survey for Henslow's sparrow, bald eagle and New England cottontail. These investigations will seek to confirm mapped areas of potential habitat within the study area.

If any population and/or habitat is determined to be affected by the project, a mitigation plan would be developed in consultation with the NHNHB, the NHF&GD, and the USFWS.

4.8 Air Quality

The study area is located in Strafford and Rockingham Counties, which are currently designated as a "Serious" non-attainment area for ozone and an attainment area for carbon monoxide. In general, improvements in the operations of the Spaulding Turnpike would be expected to improve local air quality. Widening of major transportation corridors needs to meet regional air quality conformity requirements. For traffic-related impacts, the pollutants of interest are carbon monoxide and ozone. The primary concerns will be:

1. Whether the proposed roadway alternatives will create or exacerbate violations of carbon monoxide (CO) standards, and

2. Whether the proposed action will increase or decrease the regional emissions of ozone precursors [primarily volatile organic compounds (VOCs) and nitrogen oxides (NOx)].

The air quality study will include a microscale modeling analysis that will predict CO levels at critical receptor locations along the project corridor. The microscale analysis will be conducted according to the USEPA guidelines. The air quality study will also describe the contribution of the project to the regional emissions of the ozone precursors.

4.9 Noise

During the project scoping phase, a number of study area residents commented that noise from the highway is a major concern, particularly in the vicinity of the Dover Toll Plaza. To address these issues, a noise analysis will be conducted to analyze the potential effects of the project.

The noise analysis will be designed to indicate the magnitude and extent to which noise-sensitive receptors would experience changes in noise due to improvements to the Spaulding Turnpike between Exit 1 in Newington and the Dover Toll Plaza. The noise analysis will follow the NHDOT's "*Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects*" dated July 1996, and FHWA regulations outlined in 23 CFR 772. These policies will be applied to determine what areas, if any, warrant noise mitigation measures such as noise barriers.

4.10 Socio-Economic Impacts and Secondary Effects

Socio-Economic impacts involve direct impacts to people's homes, businesses, and work places, and indirect impacts affecting access, land use, setting, travel patterns, safety, and local and regional economies. For the most part, direct impacts create hardships and need to be avoided or minimized to the extent practicable. Indirect impacts are more difficult to estimate and evaluate, and result in benefits or problems that are long-term in nature. Socio-economic issues of primary concern involve minimizing impacts to private property, while building into the proposed layout enough planning to assure the Spaulding Turnpike corridor can continue to service the transportation needs of the region long into the future.

During project impacts analysis, an econometric model (REMI) will be used to estimate the economic and social implications of direct and indirect impacts associated with alternatives identified for the no-build and possible development options. Once employment, income and population effects of the various

alternatives are estimated, the analysis will further address the potential implications of these scenarios on development and land use patterns in the socio-economic study area. The purpose of this additional analysis will be to evaluate both the capacity of respective regions in the socio-economic study area to accommodate the effects of the alternatives, as well as the potential for the alternatives for secondary growth impacts.

Comments received from the USEPA during the project scoping phase indicate that secondary land use impacts are of concern. Secondary effects can be defined as those impacts caused by the proposed project that occur later in time and are removed in distance, but are still reasonably foreseeable. Such impacts may occur due to the increased traffic capacity of an improved highway and the resultant improved accessibility within the area served by the Spaulding Turnpike.

Secondary impacts to natural resources would typically result from the conversion of existing undeveloped lands that contain such resources to residential, industrial, commercial and governmental land uses. In addition, secondary impacts can have a positive impact to socio-economic resources in terms of improving the potential for more housing and employment opportunities.

The analysis of secondary impacts is an evolving art, more than it is a science. Federal agencies such as the Council on Environmental Quality (CEQ) and the FHWA, while attempting to provide guidance, have concluded in position papers (FHWA April 2002) that there is no one correct way, nor a prescribed specific technique or method that must be used to conduct such analysis. Indeed, each secondary impacts analysis is tailored to the needs of a particular locale and project. In August of 2003, the NHDOT, FHWA, USEPA, and ACOE met on the subject of the socio-economic modeling and analysis of secondary effects. During this meeting, it was resolved that the use of the REMI model is an appropriate tool for predicting socio-economic and secondary effects associated with the project. Additionally, the USEPA stressed its desire that the DEIS address secondary land use impacts.

Following development of project alternatives, an assessment of the likely secondary impacts will be developed. The analysis will be based on the REMI economic modeling described above, but will involve other methodologies, to be determined in accordance with FHWA guidance on the issue and in consultation with resource agencies such as the USEPA and NHDES. In accordance with comments received during the scoping phase, the Draft EIS will discuss indirect and cumulative effects at least at a watershed level.

4.11 Community Environment

As discussed in Section 3.11, several public facilities exist within the study area including the Newington Elementary School on Nimble Hill Road and the property

associated with the Pease International Tradeport. No LCIP or LWCF properties are located within the study area. However, one municipally-owned recreational site is present - the Town Boat Launch on Patterson Lane in Newington. In addition, two state-owned parks are present: Hilton Park and Bayview Park, both in Dover. Impacts to these public facilities, if any, will be assessed during the analysis of project alternatives in 2004.

4.12 Aesthetic and Visual Resources

At the project's Scoping Meeting, comments were received that described the Spaulding Turnpike through the study area as the "gateway" to New Hampshire's lakes region and north country. Portions of the study area, particularly those in the immediate vicinity of the Little Bay, have a relatively rich concentration of visual elements and can be considered scenic. The Draft EIS will describe the potential effects of the project on the visual character of the study area, both for the users of the highway and for those viewing the highway and bridges from surrounding areas.

4.13 Cultural Resources

The survey of historic properties and areas of archeological sensitivity will be directed at identifying those properties and areas that are eligible for listing on the National Register in consultation with the NHDHR and FHWA. Effects on cultural resources will be considered during project alternatives analysis. Impacts will be avoided and minimized to the degree possible.

Historic properties and archaeological resources that are listed in or are eligible for listing in the National Register of Historic Places are afforded protection by Section 106 of the National Historic Preservation Act (NHPA) and Section 4(f) of the Department of Transportation Act of 1966 (see further discussion in Section 4.15 below).

Historic Structures

Perhaps the most conspicuous historic structure within the study area is the General Sullivan Bridge, built in 1935, which replaced the covered B&MC and highway bridge over Little Bay. In 1988, representatives from the NHDOT, the NHDHR, and the FHWA reviewed the General Sullivan Bridge, as part of the thematic review of continuous steel truss bridges in the state. After judging the bridge's historicity, technological significance and environmental quality, the committee deemed the bridge eligible for the National Register of Historic Places. Three other properties in the study area are currently listed or eligible for listing in the National Register of

Historic Places: the Railroad Station/Toll House at Bloody Point, the Louis C. DeRochemont Mansion in Newington, and the First Parish Church Site in Dover.

In addition to these known listed or eligible structures, a survey of the study area has found 128 potentially historic properties. The potentially eligible resources represent all eras of historical development in the two towns, from the earliest agricultural settlement in the eighteenth century to the summer cottages and industrial complexes constructed on the Piscataqua River in the early twentieth century.

Further study of historic structures will be necessary to determine which of the 128 potentially eligible properties is actually eligible for the National Register. This effort will include the fieldwork and research necessary to produce a NHDHR Project Area Form, Town-wide Forms and Intensive and Reconnaissance Level Inventory Forms. These will eventually be submitted to the Determination of Eligibility Committee for evaluation. Properties that are determined to be eligible for National Register listing will then be studied to evaluate the effects of the project on their significance.

Archeological Resources

The study area includes approximately 20 areas of known archeological sensitivity (verified sites), including the vicinity of Bloody Point. Large portions of the study area exhibit sensitivity for archeological resources as determined by a Phase IA preliminary archeological reconnaissance of the study area. These include terrestrial and marine resources, preserved as ruins, features, archeological sites and probable archeological sites. Resources are dateable to both pre-contact Native American and historic Euro-American occupancy of the study area.

A single pre-contact Native American archeological site has been previously recorded within the study area in Newington, but this site has previously been determined not to be eligible for listing. Research and field survey have defined areas of resource sensitivity for the occurrence of Native American sites throughout the study area, particularly along shorelines and stream margins.

Historic period Euro-American archeological sites have been previously recorded in and near the project area and include foundations, dumps, agricultural features and sites associated with the railroad and ferry. Research and field survey have defined additional resources and zones of resource sensitivity throughout the study area. Among these are: the Bloody Point and Hilton Point areas; Shattuck Shipyard; railroad features; brickyards; house foundations; a spring; a graveyard; and other zones of known and likely historic settlement and activity where archeological remains may be preserved.

Once alternatives are identified, a walk-over will occur along each alternative. Results and recommendation will be reported as additions to the Phase IA Report. Following the Phase IA investigation, a Phase IB study will further examine

archeologically sensitive areas. This level of study typically involves systematic subsurface testing. In addition further development of environmental and historic context associated with specific resources will be completed. Contextual and archeological site data would be integrated, site forms completed, and recommendations made for any continued investigations in Phase II. These Phase II investigations will help determine whether the site is sufficiently significant to be included on the National Register of Historic Places. Archeological recovery generally occurs during Phase III at significantly impacted sites.

4.14 Potential Petroleum and Hazardous Materials Sites

Preliminary review of the study corridor indicates a number of properties that may contain potential petroleum and hazardous waste contamination, based on the long history of commercial and industrial land use within the corridor. These areas present a constraint, including economic, to the development of alternative alignments. Further investigation and remediation will be necessary should these locations be potentially impacted by the project's construction. These potential impacts will be documented in the DEIS and considered, as necessary, in the design and construction of this project.

4.15 Regulatory Considerations

Because of the potential scope of this project, and because the project will be funded in part by federal highway funds, a number of regulatory processes apply. Summarized below are some of the reviews that may be required prior to implementation of the project.

National Environmental Policy Act (NEPA) of 1969

As part of the Newington-Dover project, the FHWA and NHDOT are developing an EIS under the provisions of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321-4347). NEPA is intended to assist public officials in making decisions based on an understanding of environmental consequences and to take actions that protect, restore, and enhance the environment. NEPA established the Council on Environmental Quality (CEQ), which advises agencies on the environmental decision-making process and oversees and coordinates the development of federal environmental policy. However, perhaps the most substantial element of NEPA requires federal agencies to include an environmental review process early in the planning stages for proposed actions. As discussed in this report, the environmental review of the Newington-Dover project will take the form of the EIS.

The NEPA EIS process is comprised of several distinct phases from the initial project announcement through the final Record of Decision. The phases include scoping (the end result being this Scoping Report document), draft EIS preparation and distribution, final EIS preparation and distribution, public hearing, issuance of the final EIS and Record of Decision, and Federal Agency Decision (sign-offs). Through this process, several public informational meetings will be held to keep the public informed of the project development and to solicit comments and concerns. Currently, a draft EIS is expected to be issued in the late summer of 2005 and a formal public hearing scheduled for fall of 2005.

Clean Water Act, Section 404 Permit

Federal protection of wetlands is regulated under Section 404 of the Clean Water Act and Section 10 of the Federal Rivers and Harbors Act. The ACOE is charged with overseeing and regulating activities in wetlands and is primarily responsible for reviewing permit applications at the federal level. The USEPA also reviews projects that may impact wetlands under the authority of the Clean Water Act and has veto authority over the permit, while the USFWS and the NMFS also have authority to comment on the Section 404 permit. Obtaining a Section 404 permit will require that NHDOT demonstrate the need to impact wetlands and that the selected alternative is the least environmentally damaging practicable alternative. It is likely that the ACOE will require mitigation in the form of wetland creation, restoration, or preservation. This project's development has followed the ACOE's Highway Methodology, which is designed to integrate the Section 404 permitting process with the requirements of NEPA. Additionally, once a preferred alternative is identified, a joint public hearing on the project will be held with NHDOT, ACOE, NHDES, FHWA, and the Special Committee responsible for the layout of the project.

NH RSA 482-A, Wetlands Dredge and Fill

The State of New Hampshire regulates activities in wetlands under RSA 482-A which requires any entity proposing to dredge or fill wetlands to apply for a permit from the NHDES. The project will likely be classified as a "major project" under the NH Administrative Rules for wetlands (Wt 100-700). This level of review is substantially similar to the review of the ACOE under CWA Section 404 as discussed above. The project need, alternatives analysis and mitigation will all be addressed as part of the Dredge and Fill Permit process. Note that RSA 482-A gives specific authority to the local community to comment on whether a permit to dredge or fill wetlands should be issued. The bulk of this recommendation responsibility is placed on the local Conservation Commissions. Through the dredge and fill permit review, the NHDES will also review the project's compliance with the NH RSA 483-B, the Comprehensive Shoreland Protection Act and other state law pertaining to protection of natural resources.

Clean Water Act, Water Quality Certificate

Under Section 401 of the Clean Water Act, the State of New Hampshire must certify that any large federally-licensed or sponsored activity (*e.g.,* highway reconstruction) will be in compliance with the state's water quality standards. This review, conducted by the NHDES Watershed Management Bureau, will ensure that reconstruction of the turnpike and bridges will not adversely affect water quality. The 401 Certificate will contain specific conditions intended to prevent degradation of surface water quality as a consequence of the project's activities (*e.g.,* soil erosion and sedimentation). Each 401 Certificate is designed for the specific project and site to which it pertains and is required to validate the Section 404 permit as well as other federal activities associated with the project. The 401 Certificate may require that regular sampling, reporting, or specific operational conditions are in place.

USCG Bridge Permit

The reconstruction, removal, modification or replacement of the Little Bay and/or General Sullivan bridges will be reviewed by the USCG. The USCG's authority derives from the General Bridge Act of 1946 as delegated to it by the USDOT. Under this authority, the USCG is responsible to preserve the public right of navigation and to prevent interference with interstate or foreign commerce. The USCG will therefore review plans for the reconstructed bridge, identifying and analyzing any change to the horizontal or vertical clearances of the existing bridges. Their review will require that the bridges provide for the reasonable needs of navigation, as well as the reasonable needs of land traffic (*i.e.,* highway users).

Coastal Zone Management Consistency

The study area is located within the New Hampshire Coastal Zone, and Federal Consistency Review will therefore be required. The Coastal Zone Management Act of 1972 established formal procedures to ensure that any project receiving funding, assistance or permitting from the federal government must be consistent with the policies of the applicable state coastal zone program. In New Hampshire, the Coastal Zone Program is administered by the NHOSP. The Federal Consistency Coordinator's review ensures that federal activities that affect any land, water use, or natural resource in New Hampshire's coastal zone will be conducted in a manner consistent with the enforceable policies of the NHCP. These policies relate to the protection of coastal resources, recreation and public access, appropriate management of coastal development, preservation of historic and cultural resources, and support of marine and estuarine research and education.

National Pollutant Discharge Elimination System (NPDES)

The reconstruction, removal, modification or replacement of the Little Bay Bridges and the Turnpike will create more than one acre of contiguous disturbed area. The project will therefore need to comply with the provisions of the Construction General Permit. This permit, administered by the USEPA, requires that NHDOT and its

construction contractor prepare a Stormwater Pollution Prevention Plan that addresses the site specific measures to be used throughout construction to limit the potential for erosion and discharge of sediment into surface waters. Just prior to construction, NHDOT and its construction contractor(s) will be required to submit a notice of intent certifying that they are in compliance with the provisions of the Construction General Permit.

National Historic Preservation Act

As discussed in Chapter 3 and in Section 4.13 above, the study area contains regions of archeological sensitivity and has several structures that are either known or potentially historic. Section 106 of the NHPA requires federal agencies to take into account the effects of their activities and programs on any historic district, site, building, structure, or object that is included, or eligible for inclusion, in the National Register of Historic Places. The resources and the effects on those resources are evaluated by the SHPO and the federal agencies having jurisdiction, in this case the FHWA.

The procedures followed in the Section 106 review are referred to as the "Section 106 process" and are set forth in regulations issued by the Advisory Council on Historic Preservation (ACHP), *Protection of Historic Properties* (36 CFR 800). The ACHP does not have the authority to halt or terminate projects that will affect historic properties. Rather, its regulations emphasize consultation among the responsible federal agencies, the SHPO, and other interested consulting parties, to identify historic properties, evaluate eligibility, determine the potential effect of the project on historic properties, and if possible, to agree upon ways to protect the affected properties through avoidance and/or through minimization or mitigation of the effects.

The Section 106 consultation has already begun with a coordination meeting between NHDOT, FHWA and NHDHR in September 2003 during which initial historic and archeological investigations were discussed and refined. Further discussions with NHDHR will occur throughout the project to further define those properties within the study area that are eligible for listing on the National Register of Historic Places and to assess potential impacts. The process will also allow for the participation of interested parties, who may be granted "consulting party status." Prior to the approval of the undertaking, the ACHP will have an opportunity to comment on potential historic resource impacts.

Section 4(f) of the Department of Transportation Act

Section 4(f) of the Department of Transportation Act of 1966 (49USC 303) states that "…special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic sites." Regulations governing 4(f) implementation specify that there can be no taking of public-park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible

alternatives. Such alternatives may range from project modifications to "no-build." If it is determined that no prudent and feasible alternative exists and that public park or recreational lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation of other alternatives would result in extraordinary costs, and/or social, economic, or environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to these historic properties and other public resources.

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